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ILLUMINATING ENGINEERING

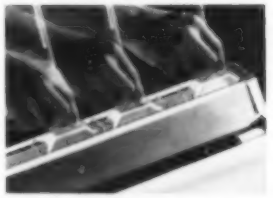
Journal of the
ILLUMINATING ENGINEERING SOCIETY

The beautiful **CAVALIER** *by Wakefield*

the luminaire de luxe

with the wonderful

sliding stem plate



The Wonderful Sliding Stem Plate

completely eliminates problems of in-line spacing of mounting points. It can be moved along the channel at will, to support the luminaire at any point. An additional convenience feature is the Wakefield adjustable ceiling strap which provides up to 1" adjustment of out-of-line or in-line error in location of mounting points.

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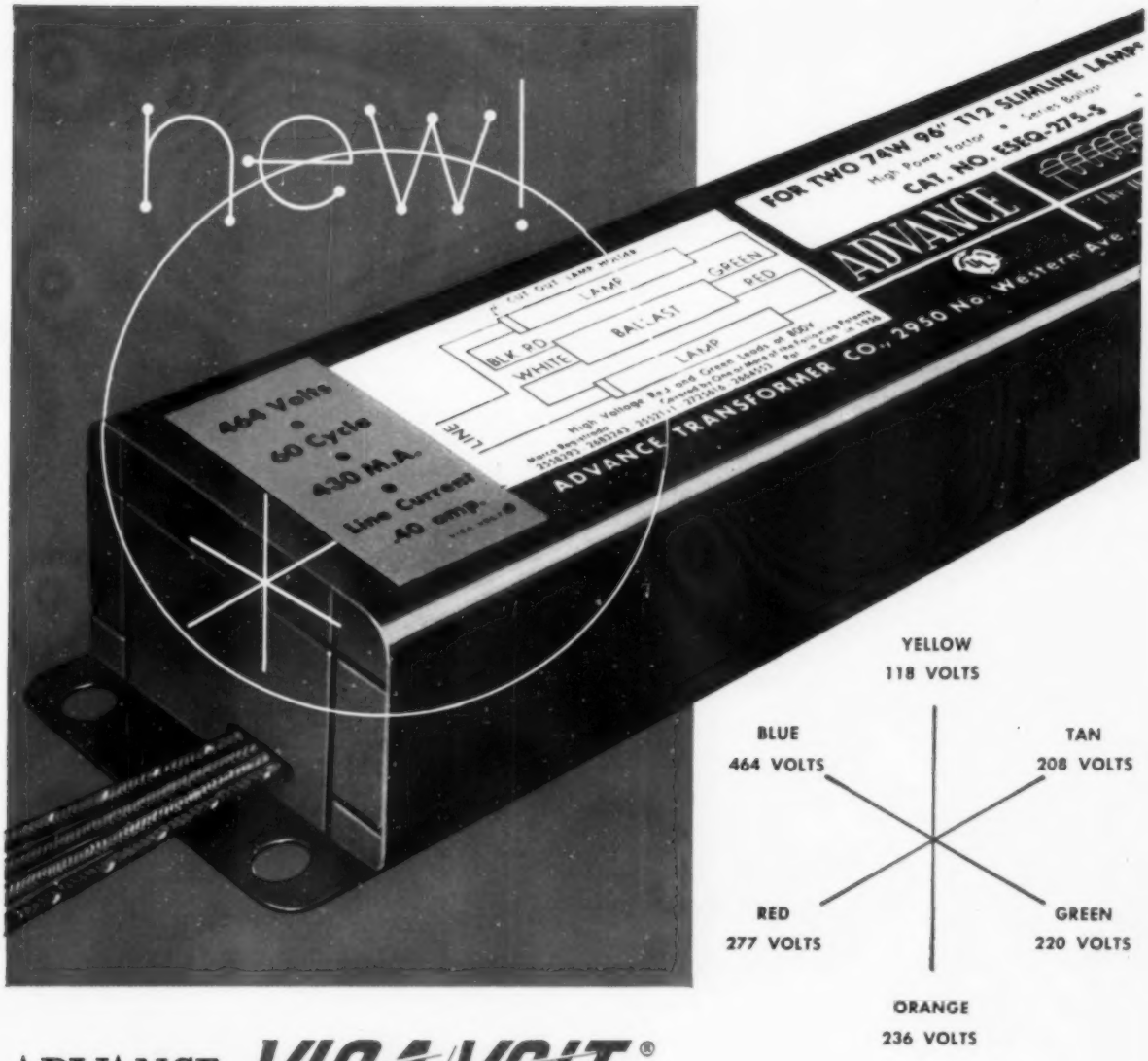

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Vol. LII, No. 6

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ILLUMINATING ENGINEERING SOCIETY

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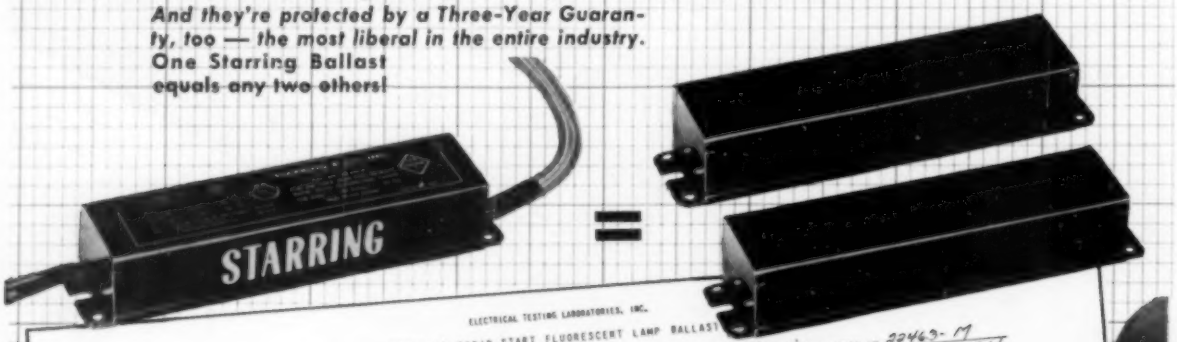

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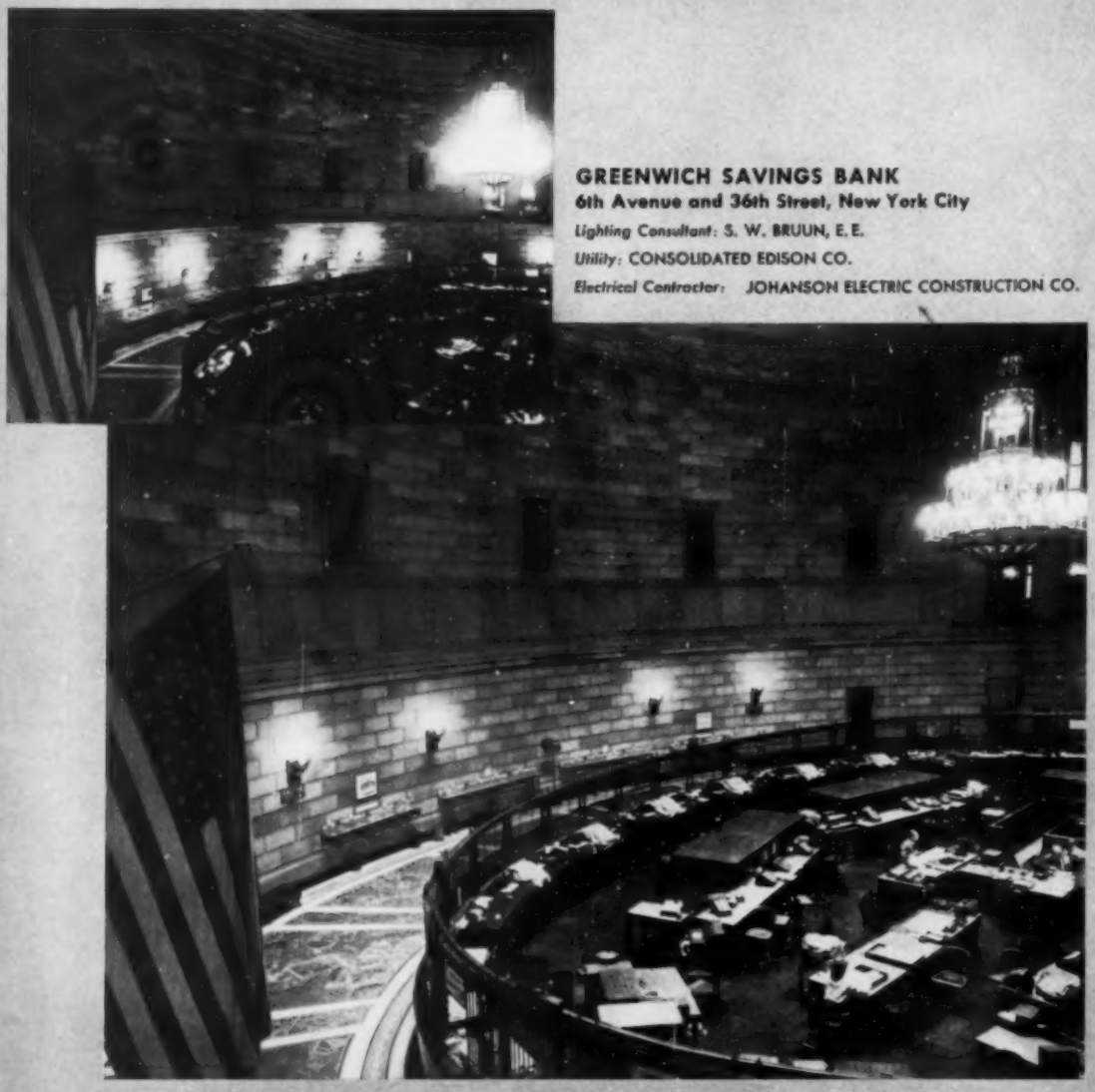

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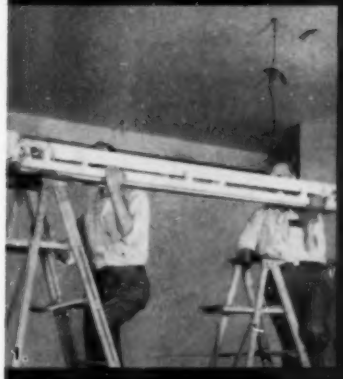

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1. Clamp hangers are mounted to ceilings or stems. Pre-wired grid is lifted to ceiling, inner packing intact.

2. Large channel is suspended from clamps. The small channels are moved outward, spaced by locked-in tubing, and suspended from clamps.

3. Additional grids are installed as required.

4. Spoke hangers are mounted to grid. Inverted "T" framework, is attached, lamps and CurtiCell panels are installed.

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Right after this photograph was taken an illuminating engineer from an independent laboratory took Footlambert readings. His findings are as follows: each of the battery of photographer's floodlights produced 20,000 FL; the six Honeylite panels gave overall 340 FL readings; the little girl's face showed 120 FL; and the page in her picture book was all the way down to 50 FL . . . a light soft enough for the youngest eyes!

See our Catalog in Sweet's file 31a/He

* Footlambert — the standard unit of surface brightness — as measured with a Spectra Brightness Spot Meter. Name of testing laboratory available on request.

HONEYLITE®

LIGHT-DIFFUSING ALUMINUM HONEYCOMB

A DEVELOPMENT OF HEXCEL PRODUCTS INC.

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Designed Lighting in Homes

By RUTH PATTERSON

II — Accent and Decorative Lighting

LIGHT can be used to focus the attention. Indoors, furnishings are made more attractive and centers of interest created by concentrating light in certain areas. A room with only general illumination can seem dull or flat. Accent light adds variety and drama.

Outdoors, a building and its surroundings can be more distinctive and enjoyable, when suitably lighted at night.

AUTHOR: Lighting Consultant, Dallas Power & Light Co., Dallas, Texas.

A pierced downlight gives a puddle of light on the floor for safety, and an adjustable eye-ball spot highlights a beautiful cabinet.

A large planter in a bay window is lighted by four 75-watt reflector lamps in adjustable sockets concealed behind a 13-inch deep board. Indoor planters need light to prolong life of plants as well as for decorative appeal.

Entrance hall catches the attention with a recessed downlight located close to the wall to light a picture and planter.

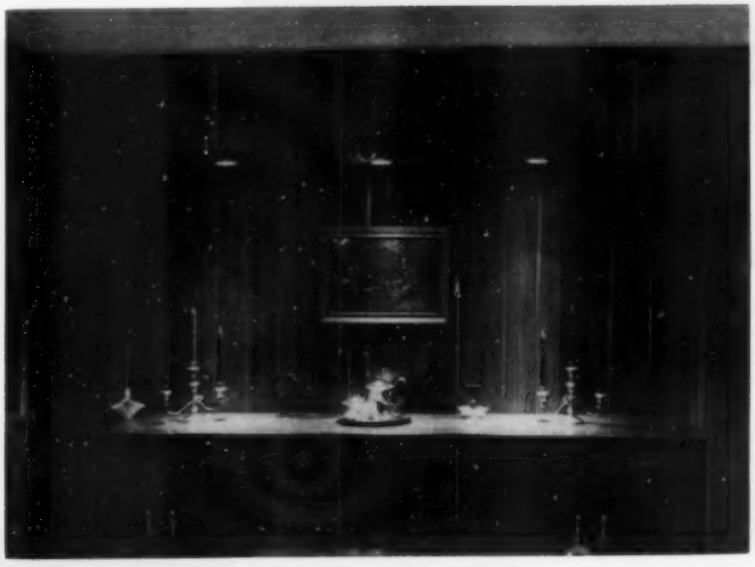
Adjustable recessed spots accent the decorative center of interest in a hallway (right).

Unusual equipment is used for accent in this dining room (below). A very small showcase strip lights the Japanese screen on the wall. A small, but intense, spot of light is provided for the fruit arrangement on the buffet by 30-watt automobile lamps (4½-degree beam spread) in semi-recessed fixtures complete with transformer for operation at 110 volts. A pin-hole optical downlight is recessed over the table giving a controlled beam which lights just the table top.

This little dining room did not have the advantage of a view of the sea, being an inside room. So one was built. A false wall was built 12 inches inside the actual wall. The window is about 4½ feet high and 10 feet long. Wall paper mural is used to back the window, with ends curved toward the inside wall to help create an illusion of distance, as do wrought iron and plants at the window line. A continuous row of light is used at top and bottom.

Accent on the dried flower arrangement (right) is furnished by a recessed eye-ball spot. Louvered recessed fixture over the window gives accent to the draperies.

Three recessed louvered spots light a buffet (below) and give sparkle to the silverware.



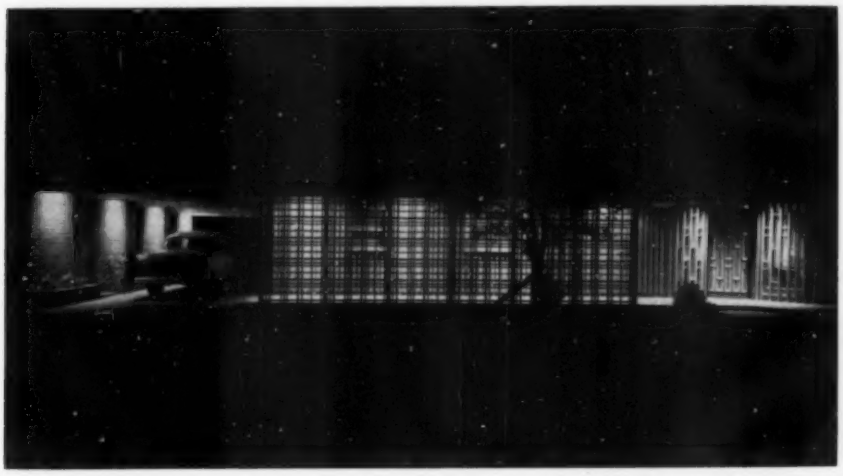
For decorative accent as well as functional use, so that either person can read in bed without disturbing the other, pin-hole optical downlights are used over the head of each bed. The light is shuttered so that it lights only the pillows.

Beautiful china, crystal and silver is handsomely displayed in a china cabinet with a row of lights concealed at the top front edge.

A pendant decorative fixture highlights a mosaic game table. The room (right) has a wash of light on the picture wall from 150-watt reflector lamps in recessed shovel downlights or wall washing units. These are located 3½ feet from the wall (behind the beam) on 3½-foot centers.

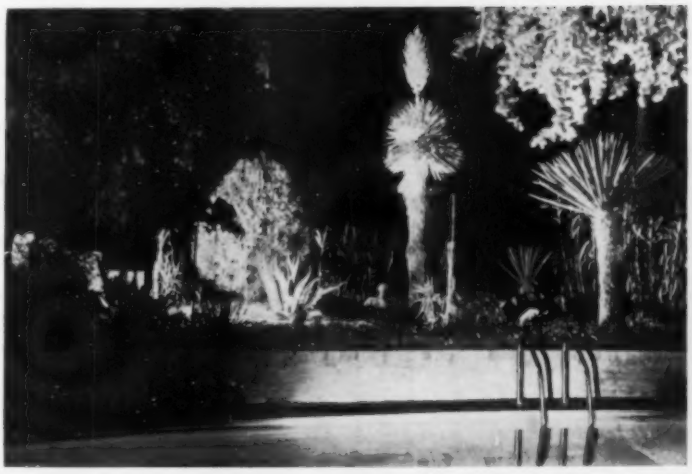
If a patio has wide eaves (below), recessed louvered fixtures can be used close to the house to provide background light on the wall. Tree lighting provides accent.

Architectural features can be emphasized by planned lighting. Here six recessed fixtures are located immediately behind the columns. This hides the source, lights the entire wall across the porch and silhouettes columns.



Louvered fixtures are recessed in the eaves to dramatically highlight the front of the house. Silhouetted screens lend architectural character to the scene.

View from a patio, across a swimming pool, is a small tropical garden lighted by three 150-watt PAR-38 floods in weatherproof holders with ground spikes and portable cords and plugs.



Harnessing Daylight With Frosted Glass

GENEROUS quantities of daylight from windows and skylights proved an embarrassment of riches in glare and heat problems, at the Detroit Diesel Engine Division of General Motors. The building, of about 130,000 square feet floor area, has all exterior walls of window glass and a roof with approximately 32,000 square feet of monitors and skylights.

Painting the windows and skylights with a recommended special paint for glass seemed the easiest solution — and this was done to all window areas except those on the north exposure. This reduced the glare to an acceptable minimum, but also necessitated the use of an electric lighting system, even on bright days, for sufficient illumination. In addition, it was found in less than two years that the paint was beginning to fade badly, coming off in spots, and the glass surfaces were unsightly in general. Removal of the old paint and repainting was going to cost 24¢ per square foot, and would be necessary every three years.

Looking around for a better method than paint for daylight control, an investigation of frosted glass brought attention to a technique for sandblasting it right in the sash, as done by a local contractor. This process was tried, first on the west exposure, a particularly troublesome spot for heat and glare. All windows were frosted with the exception of the bottom two rows of panes, which were left clear as a vision strip.

Results appeared satisfactory in all respects. Transmission of visible light is sufficient (20 per cent loss), and diffusion of the sun's rays is achieved to an extent that no one has since complained about glare. Heat loss is also about 20 per cent. The frosting gives the glass a pleasing whiteness.

An unexpected bonus is the degree to which the frosted glass is self-cleaning, through the action of rain. After four years of use, without other cleaning, the frosted panes have apparently collected no excessive dirt. The two rows of clear vision strip panes are cleaned every six months.

This investigation of paint *vs* frosted glass for daylight control was carried out by C. T. Gruner, Supervisor, Plant Engineer, Detroit Diesel Engine Division of General Motors, and reported in *Industry and Power*. Photographs and information courtesy of Floyd Sell, Detroit Edison Co.

The first part of this lecture, published in the May 1957 issue of ILLUMINATING ENGINEERING, reviewed British and other European work which has been completed or published since the C.I.E. Meeting at Zurich in 1955. The second part of the lecture, given here, includes new work on glare recently completed or still in hand at the Building Research Station, Garston, Watford, England.

The basic formula for the evaluation of glare discomfort is reviewed and some of its many limitations discussed. Cross-checks undertaken during the last few years at the Building Research Station show that nevertheless it still serves a valuable purpose for practical lighting engineering, provided too great a precision is not sought. The additivity of glare is discussed, in relation to the saturation characteristics of the adaptation mechanism. It is suggested that the simple addition of the glare effects of a number of sources can never give a "true" solution, but that it often yields a result of adequate precision for most present-day lighting problems. The greatest need for further research is in the study of the discomfort caused by very large sources of moderate luminance, such as occur in daylighting or in the use of "overall" ceiling lighting.

Evaluation of Glare

By R. G. HOPKINSON

Basic Glare Formula

RECENT WORK AT THE Building Research Station on glare discomfort followed on informal meetings which were arranged at Stockholm in 1951 in conjunction with the C.I.E. Congress.

At these meetings, agreement was reached by all that the main factors which govern glare discomfort are the following:

(1) Luminance of the light sources.
(2) Apparent size of the sources.
(3) General level of adaptation.
(4) Position of the sources relative to the direction of viewing.
(5) Luminance of the immediate surrounds to the sources.

It was further agreed that glare discomfort could be assessed on the basis of an expression of the form:—

$$\text{Glare constant} \quad G = \frac{f(B_s) \cdot f(Q) \cdot}{f(B_b) \cdot f(B_i) \cdot f(\theta)} \qquad (1)$$

where B_s = source luminance
Q = apparent size of the source
B_b = adaptation luminance
B_i = luminance of immediate surround to the source
θ = angle between direction of source and direction of viewing

The higher the value of G, the greater is the degree of discomfort. Thus greater source luminance and apparent size make for worse glare; greater adaptation level, immediate surround to the source or angle between direction of source and direction of viewing make for less glare.

To a first approximation the formula (1) can be expressed as:

$$G = \frac{B_s^2 \cdot Q}{B_b} \quad \text{or} \quad G = \frac{B_s \cdot E_s}{B_b} \qquad (2)$$

where E_s is the illumination on the eye *from the sources.*

This modified formula was put forward by the British National Committee at the C.I.E. 1955 conference as a basis for the derivation of a set of international glare tables.

Part II of a lecture given at Cornell University, Ithaca, N. Y., September 1956, to a symposium on Visual Research held by the Illuminating Engineering Research Institute of the U. S. A.

AUTHOR: Dept. of Scientific and Industrial Research, Building Research Station, Garston, Watford, England.

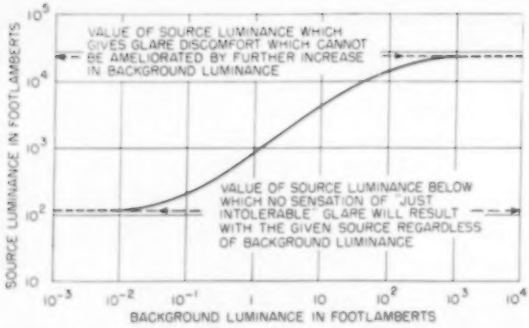

VALUE OF SOURCE LUMINANCE WHICH GIVES GLARE DISCOMFORT WHICH CANNOT BE AMELIORATED BY FURTHER INCREASE IN BACKGROUND LUMINANCE
VALUE OF SOURCE LUMINANCE BELOW WHICH NO SENSATION OF "JUST INTOLERABLE" GLARE WILL RESULT WITH THE GIVEN SOURCE REGARDLESS OF BACKGROUND LUMINANCE
SOURCE LUMINANCE IN FOOTLAMBERTS
BACKGROUND LUMINANCE IN FOOTLAMBERTS

Figure 1. The sigmoid nature of the relation between source and surround luminance for constant degree of glare discomfort.

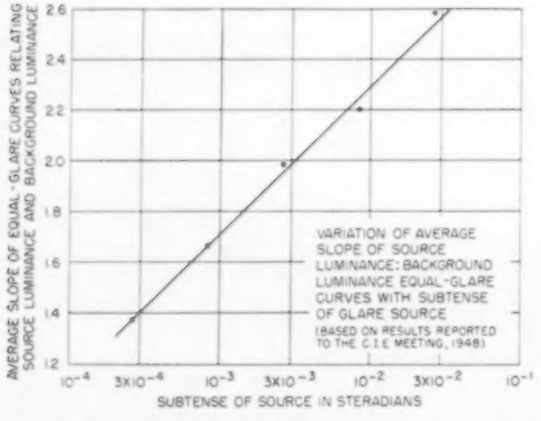
Exponents in the Basic Glare Formula

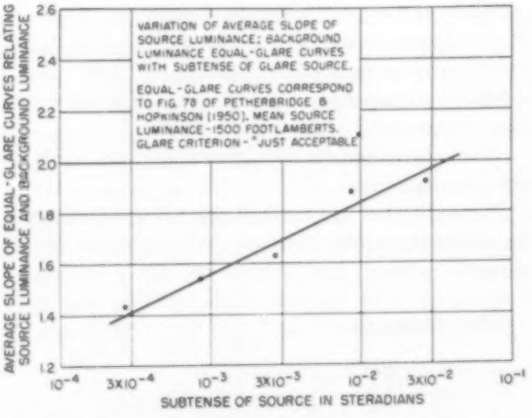
The basic glare formula breaks down in a number of ways and cannot be regarded as more than an approximation which is convenient for some purposes.

(1) At very high adaptation luminance levels, of the order of 5000 footlamberts and above, the visual adaptation mechanism begins to saturate. If a glare source is so bright and large that glare discomfort has not been eliminated even though the surround luminance has been raised to 5000 footlamberts, no further increase in surround luminance will produce any amelioration. On the contrary, the surround itself will begin to cause discomfort. There is no longer any question of a balance between the source and the surround luminance. This implies therefore that the exponent of the term B_b in the glare formula as given above with B_b in the dedenominator decreases as the values of Q and B_s increase, and becomes negative when Q is very large and B_s is about or above 5000 footlamberts (the exact value of the changeover depending on the visual characteristics of individual subjects).

(2) The basic glare formula embraces a simple power law between the source luminance B_s and the surround luminance B_b. This simple relation breaks down under certain circumstances. First, especially if the source is very large, there is a level of source luminance above which the source is glaring no matter what the value of the surround luminance. There is also a level of source luminance below which the source causes no glare even if seen in total darkness. The relation between the logarithms of the source luminance and surround luminance is therefore a form of sigmoid, and not linear. (Fig. 1.) It is an approximation, but a reasonable one, to consider it linear over a limited range.

(3) If we accept the approximation to a linear relation between the source and the surround luminance on a logarithmic scale, it might be expected that the exponents of B_s and B_b will depend on the apparent area of the source, since as this area increases, the area of the surround must necessarily decrease since the total area of the visual field is constant. It might be deduced, therefore, that the influence of the source luminance would become greater as its area increased. This has been shown to be the case experimentally. There are three quite separate sets of data available from my own studies. Originally, in the course of the study on glare in lighted streets, it was shown that, as the source area increased, the exponent of the source luminance also increased relative to that of the surround luminance. With point sources the ratio of the two exponents (of source and of surround) was 1.0, with large sources


AVERAGE SLOPE OF EQUAL-GLARE CURVES RELATING SOURCE LUMINANCE AND BACKGROUND LUMINANCE
VARIATION OF AVERAGE SLOPE OF SOURCE LUMINANCE: BACKGROUND LUMINANCE EQUAL-GLARE CURVES WITH SUBTENSE OF GLARE SOURCE
(BASED ON RESULTS REPORTED TO THE C.I.E. MEETING, 1948)
SUBTENSE OF SOURCE IN STERADIANS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EQUAL-GLARE CURVES CORRESPOND TO FIG. 78 OF PETHERBRIDGE & HOPKINSON (1950). MEAN SOURCE LUMINANCE-1500 FOOTLAMBERTS. GLARE CRITERION - "JUST ACCEPTABLE"
SUBTENSE OF SOURCE IN STERADIANS

Figure 2. Relation between apparent size of glare source and average shape of source/background luminance curves, (left) determined by four observers (Hopkinson 1948), (right) determined by six observers (Petherbridge & Hopkinson 1950).

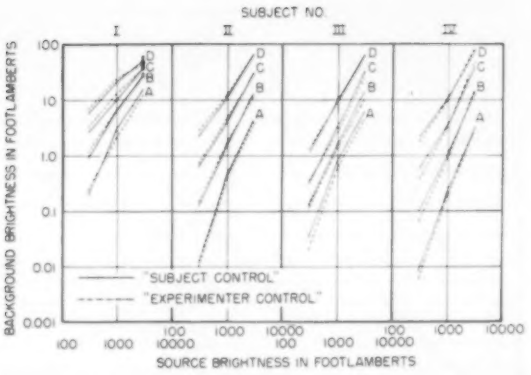

Figure 3. Relation between source and surround luminance for four constant degrees of glare: A, just intolerable; B, just uncomfortable; C, just acceptable; D, just perceptible. The shape of the relation for A is steeper than that for D. The borderline between Comfort and Discomfort (BCD) lies between Criterion B and Criterion C. (The curves also show that the same judgments apply whether the subject himself or the experimenter exercises control of the physical variable.)

it approached 3.0. Next, when the work was first resumed in 1947, a similar relation was found, and was reported in a paper to the C.I.E. in 1948. (Fig. 2.) Finally, the more extensive work with a larger number of observers (Petherbridge, Hopkinson (1950)) confirmed the same trend, but to a less marked degree.

(4) The θ function again depends on the area and the luminance of the source. Consequently the θ function, or Position Index as it is called by Luckiesh and Guth, is not independent of the other factors in the glare formula.

(5) The B_i function (the influence of the immediate surround to the source) cannot be expressed in any simple form. The influence of the luminance of the immediate surround to the glare source depends on the size of the source and the size of the immediate surround. Clearly if this immediate surround is very large, it begins to influence the adaptation to a marked extent. If it is very small, a mere annulus around the glare source, it has little influence on the degree of glare. If it is of a size as to influence glare, this influence is exercised only over a limited range of luminance. As the luminance of the immediate surround begins to approach that of the glare source, glare increases rather than decreases. The exponent of the B_i term therefore changes from a positive to a negative value, in the position in which it is shown in the denominator of equation (1).

(6) The matters discussed in (1) to (5) above apply equally to determinations of glare expressed in terms of the borderline between Comfort and Discomfort (BCD) and to determinations expressed in terms of other criteria of discomfort. The BCD does not tell us all we need to know about the sensation of glare, however, and for this further information we need a scale of glare sensation such as that provided by the Multiple Criterion system, in which all the many studies, both the early work and that at the Building Research Station, have been conducted. The relations expressed in formula (1) above are then found to be not the same for different criteria, *e.g.*, "just perceptible" glare, or "just intolerable" glare. Broadly, the influence of the surround or adaptation luminance on "just perceptible" glare is less relative to that of the source luminance than it is on the BCD, and still less than it is on "just intolerable" glare. (Fig. 3.)

By working with the BCD only, these additional complications can be escaped, but it is the escape of the ostrich, for they are there all the same, and they are important in practical lighting.

(7) So far the simple conditions of one glare source in the field of view have been considered. If there are many sources, we need to know how can their effects be assessed. This problem will be discussed again later.

The first stages of the work at the Building Research Station showed that the glare effect of a number of sources of the same luminance was the same as that of one source, in the same mean position, of the same apparent area as the sum of the apparent areas of all the sources. In practice it has been found that simple additivity on this basis works, but only over a limited range of conditions. If we think about the situation, we could not reasonably expect otherwise. Simple additivity of large bright sources cannot apply if the relation between source and surround luminance shows saturation characteristics, as we have already seen that it does. The departure from simple additivity will be more serious the larger and brighter are the sources being added, and the higher the surround luminance consequently necessary to "balance out" the glare which they cause. These conditions apply in practical lighting in the U.S.A., but to a less extent in Europe, where levels of lighting are generally much lower. The departure from simple additivity is a problem which has concerned you more than it has us, but it is one which we ought to settle in the course of achieving international agreement.

The above summary does not exhaust the discrepancies in the simple basic glare formula, but it is sufficient to offer such a gloomy picture that we might well ask, of what use is the formula anyway?

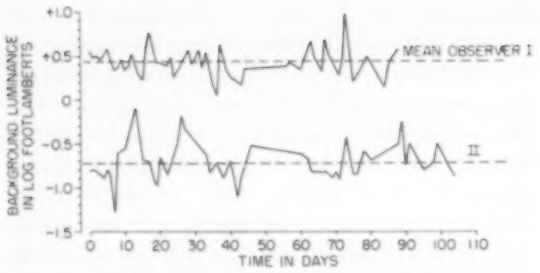

Figure 4. Day-to-day assessments made by two experienced observers of the background luminance necessary to balance out the source luminance to the criterion of "Just Uncomfortable" glare. The mean is steady over a period of three months, but the actual values differ considerably.

Observer Variance

The answer to this question depends on the level of precision to which we aspire. If we are making a study of vision by the aid of subjective judgments of glare discomfort, all these discrepancies are important because they may reveal the working of some parts of the visual mechanism. If, however, our purpose is to devise a working tool to enable designers to avoid glare in lighting installations, we can decide arbitrarily the precision to which we all agree to work. The precision must depend on the variability of the judgments on which the various expressions are based.

In our studies at the Building Research Station most of the judgments were made by a small team of six observers; the same applies to my original studies on glare in lighted streets. Guth also employed a small team for the majority of his detailed studies. Within each of these small teams there were wide variations in the individual judgments of discomfort. In our own studies we had sufficient observations over a long period to study the consistency of these judgments. It was clear that each observer maintained his criterion over many weeks, even though this criterion was different from that of each of his colleagues. (Fig. 4.) These results all demonstrate that there are real differences in the sensitivities to glare of different individuals, that these differences are large, not negligible, and that they were maintained throughout the weeks during which the subjects made their extensive series of observations.

Wide though the variations are between the sensitivities to glare of individual subjects in our main team, the variations between individuals in the general population are wider still. We obtained series of judgments from 50 subjects selected very much at random from the staff of the Building Research Station, including a large proportion of non-scientific people. The variations were very considerable. Included in this group of 50 were some who did not understand what was demanded of them, and some whose over-anxiety to obtain the "right" answer affected their judgment. The variations were far greater than those obtained by Guth, or those which I obtained myself in the course of the street-lighting study, but in the latter case, and perhaps in the former, the subjects were mostly scientifically trained people who quickly grasped what was required of them.

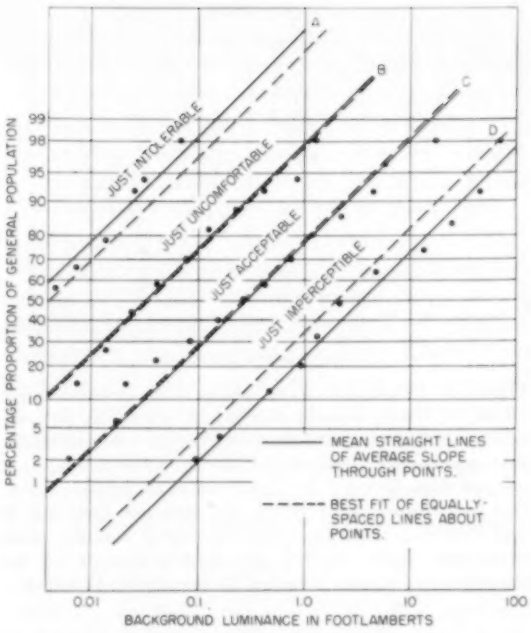

Figure 5. Variation with background luminance of the percentage of general population who would assess glare discomfort in a particular environment at the given level or less uncomfortable than the given level. Source luminance: 300 footlamberts.

These judgments from our 50 random subjects have been analyzed, for what they are worth. They plot well on a probability diagram, where the enormous variances can be readily appreciated. (Figs. 5, 6 and 7). The conclusions to be drawn from these results are as follows:

1. The mean of the observations of the "random" observers is not the same as that of the experienced team of six people. There are consistent differences throughout the series of observations.
2. There is, for example, a relation between the means for the 50 observers and for the six observers, in that the mean judgments differ by approximately one criterion on the multiple-criterion scale (for example, if a given situation is judged on average as "just intolerable" by the six-observer team, it will be judged on average as "just uncomfortable" by the 50-observer team). *The general population is less sensitive to glare than the experienced team.*

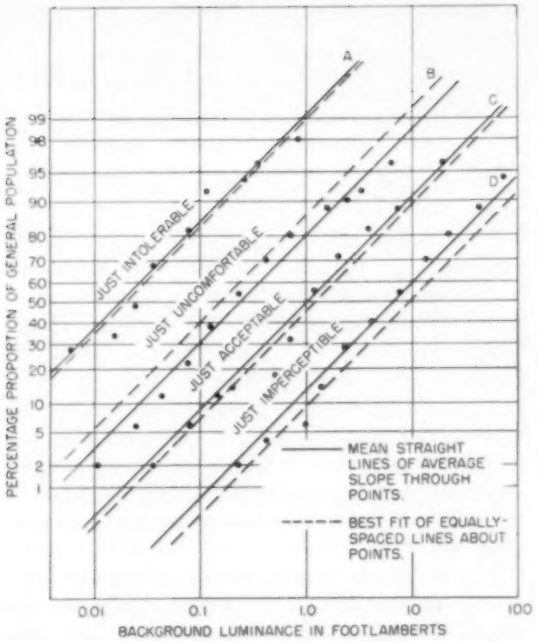

Figure 6. As Fig. 5, with sources at 1000 footlamberts.

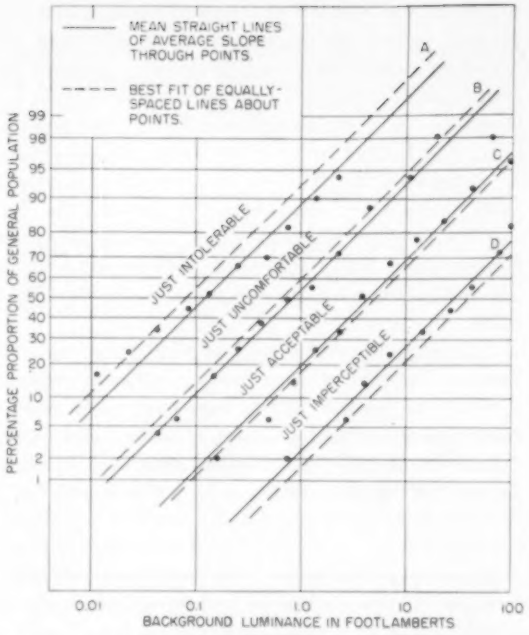

Figure 7. As Fig. 5, with sources at 3000 footlamberts.

3. Approximately 80 to 85 per cent of the general population would experience less glare discomfort in any given situation than the mean observer of the experienced six-man team.

There is therefore available information which enables us to decide the degree of precision to aim for in any practical statement of the glare phenomenon. One the one hand we have information on the variances in the judgments of experienced subjects, the consistent differences in their mean assessments expressed in terms of the standard error of their day-to-day judgments, and finally the variance of the judgments of the general population related to the judgments of the experienced team. The decision on the degree of precision to be aimed at in any international statement on glare must be made by the Working Party appointed by the C.I.E. Later I shall summarize the procedure which we use ourselves at the Building Research Station to evaluate glare.

Influence of Method of Experimentation

So far we have examined the glare formula, the conditions in which it can be expected to break down, and the experimental evidence on which we can base our decision as to the degree of precision which we expect it to perform in practice. The next stage is to consider to what extent the method of experimentation influences the results.

Most of the American work on glare has followed Holladay and Luckiesh's original method of presenting the glare source in one-second "flashes," rather than presenting it continuously in the field of view. We have never followed this practice in Europe, that is to say in England or in Holland, because we argue that in a glare situation, both source and surround are continuously present, and the sensation of discomfort that results is due to the continuous interplay of the relevant mechanisms of vision. The "flash technique" gives reliable results, but they are not necessarily measures of the form of glare discomfort with which we are concerned.

In order to study the effect of the method of experimentation, we undertook an extensive series of observations. Three observers only took part, but unfortunately these three individuals were found, after the results had been analyzed, to differ very considerably in their glare sensitivities. For this reason the results were never published because it was hoped one day to repeat them with other observers, but this has not proved possible. They are offered here with all possible reservations. The body of data is considerable, running to many thousands of observations in the laboratory report. It is at the disposal of any worker in the subject if it is felt to be useful.

The experiments were conducted in our model apparatus and also in a large white cubical space designed to match as closely as possible the apparatus used by Guth. The source was presented both by the "flash" technique and by the "continuous

exposure" method. In some sets of experiments the subject varied the surround luminance, and in others he varied the source luminance. In some he judged on the Multiple Criterion scale (A, just intolerable; B, just uncomfortable; C, just acceptable; and D, just perceptible glare), and in others he judged by the BCD scale. A visiting scientist from South Africa acted as one of the subjects. He was not familiar with either the Building Research Station scale or the BCD scale when he commenced his judgments. He judged initially on the BCD scale.

The range of conditions was wide, each variable (source luminance, surround luminance, source (100:1) or greater. The "flash" exposure conditions followed the Luckiesh-Guth 10-second cycle (three one-second "on" periods separated by one-second "off" periods followed by a five-second "off" period before the next "on" period). The results showed:

1. Momentary exposure results in a slightly greater degree of glare than continuous exposure.
2. If the source luminance is varied by the subject, he appears to be slightly more sensitive to glare.

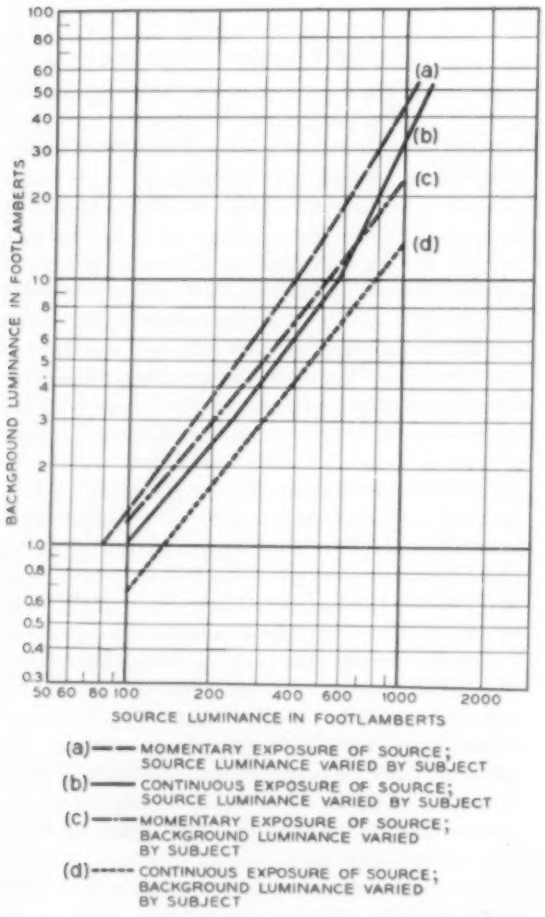

Figure 8. Comparison of glare judgments for four methods of study, using the BCD as criterion. Method (a) is the Luckiesh technique, method (b) the Hopkinson technique.

The greatest difference between the means of the results for the four systems (momentary exposure and variation of source luminance, momentary exposure and variation of surround luminance, continuous exposure and variation of source luminance, continuous exposure and variation of surround luminance) is less, however, than the consistent differences between the three observers. Despite these differences in individual sensitivities, however, all subjects varied in the same sense and in particular showed a higher sensitivity to glare when using the Luckiesh-Guth technique of momentary exposure with variation of source luminance. (Fig. 8.)

It is of interest to note where the BCD criterion lies in relation to the four criteria of the Building Research Station multiple-criterion scale. The visiting scientist, who had no previous experience of glare judgments on either scale, made his first judgments by the BCD and his later judgments by the multiple-criterion scale. He placed the BCD between "just uncomfortable" and "just acceptable," a result which confirmed the comparison which I showed at Stockholm of the entirely independent studies of Luckiesh and Guth on the one hand, and of Petherbridge and myself on the other. In this present study, which of course did not figure in the Stockholm comparison, averaged judgments of our three subjects for the BCD also lay between "just uncomfortable" and "just acceptable" irrespective of the experimental technique being used.

The standard error of the observations using BCD was 0.17, log. luminance units, which compares with 0.16 for a much more extensive series using the multiple-criterion method. These three "skilled" observers therefore managed quite as well with the BCD as with the multiple-criterion method.

A further interesting result from these studies was that for two of the observers the relation between the source area and the source luminance for the BCD criterion followed the slope given by Luckiesh and Guth more closely when the Luckiesh-Guth exposure technique was used. The third subject's observations, however, were consistent throughout with the slope of the original Building Research Station glare formula, no matter what technique was used.

There were many more cross-checks involved in

this study, but sufficient has been given to show that, if anyone hopes to resolve the discrepancies between the American and the European work on glare, they will have to employ a very large number of observers and engineer the experiment on the lines of a military operation as Blackwell, to his great credit, has done in his contrast threshold work. Anything less is a waste of time.

We were, however, able to provide sufficient data to afford a reliable comparison between glare judgments made in our model apparatus and those on a full scale. For this study a larger number of observers were employed and we were able to establish that the judgments on a full scale always fell within the relevant confidence limits of the model scale assessments. (Ref. 8.)

Most of the work reported above was completed early in 1952, and I read a paper summarizing the results to the French Association of Lighting Engineers at their congress at Toulouse in May 1952. (Ref. 4.) Glare has been lying dormant at the Building Research Station since then, until last month we were able to take some time from our other work to study some of the effects of additivity. These results are still coming off, and we have not analyzed or assimilated them yet.

The Additivity of Glare

This work was started as a result of the C.I.E. meeting at Zurich in 1955, where it was clear that workers in the U.S.A. were unwilling to accept the simple additivity function advocated by the British delegation, yet did not offer any alternative based on sounder principles.

It would be a great mistake if the impression were given that the simple additivity function is believed by us to be fundamentally true. It is not, and clearly cannot be, for many reasons, some of which have already been discussed. It was advanced as a simple and practical expedient, which could be shown to agree reasonably well with the experimental facts, within the limited degree of precision which the British proposals as a whole set out to attain.

In any discussion on the additivity of glare, it is important to distinguish most carefully between the addition of the stimuli and the addition of the sensations. To abide by this precept is something which even the great have often failed to do. But if this distinction is not made both in thought and in the expression of thought, much of what is written is meaningless, however erudite it may at first appear to be.

The work on glare in street lighting (Hopkinson 1940) showed that, within the limits of the luminances and sizes of the sources, and the luminances of the background then under study, glare was additive. The expression there used for the additivity function was, that the background luminance necessary to balance the glare from a large number of sources (for a given criterion of discomfort) was equal to the arithmetic sum of the separate background luminances necessary to give the same criterion of discomfort with each of the sources seen separately. In other words, if:

$$B_b' = \frac{f(B_s') \cdot f(w')}{G} \qquad \text{for one source}$$

$$B_b'' = \frac{f(B_s'') \cdot f(w'')}{G} \qquad \text{for another source}$$

and so on,

then the background B_b for all sources seen together $= \Sigma B_b' + B_b'' + B_b'' + \ldots\ldots$ for the same criterion of discomfort throughout.

This was established experimentally.

The later work (Petherbridge and Hopkinson 1950) showed that this simple additivity of background luminances did not apply to low luminance sources, though it did to high luminance sources (such as had been studied for the street lighting investigation), but that to a reasonable degree of accuracy it could be accepted as a practical method for the calculation of glare effects. A summation more in accord with the experimental facts was given, *i.e.* that "the glare effect from a number of sources is the same as that from a single source of the same total apparent area in the same mean position." This has subsequently been shown to be an acceptable statement for most conditions met in practice.

The most recent work has been conducted:

(a) to show the probable extent of the error involved in the assumption of a simple additivity function in situations likely to be met in practice,

(b) to show whether the way in which a number of sources are disposed in the field of view affects the additivity of the discomfort effects,

(c) to determine whether a more complete picture of the mechanism of glare can be obtained, which would yield a more fundamental and more acceptable basis for the simplifications to be introduced for practical lighting calculations.

With the limited resources at our disposal, this work advances slowly. An interim report must necessarily be unsatisfactory, because it leaves unanswered so many questions which later results may resolve.

No useful purpose is ever served by erecting hypotheses to explain experimental findings unless these findings embrace the whole problem. On

glare we have not the body of knowledge to justify the advancement of a hypothesis — we still do not know just why discomfort is caused by bright sources and exactly what visual and mental process are involved in the relation between stimulus and glare sensation. Nevertheless we can avoid a great deal of unnecessary work if we search for a limited explanation of our empirical results, even if this explanation does not constitute a hypothesis.

Two distinct situations at least seem to create a condition which gives rise to discomfort. First, the eyes may be dark-adapted (or partially dark-adapted) and the presence of bright sources acts as an "emotional affront." These sources may not, however, be so bright that the eye could not adapt to their luminance alone, *i.e.* the retinal stimulation is not maximal, it is simply that their presence in the darker field is the cause of the discomfort. This is the kind of situation met in lighted streets for example. The second situation arises when the whole field or a large part of it is extremely bright, and the eyes are fully light-adapted, but still unable to adjust themselves to the high luminance. Luminances of the order of, or brighter than, snow in full sunshine are in this category.

Practical situations can involve one or the other or a combination of these basic situations. Consider a simple case of the former. If a small source of, say, 500 footlamberts *(i.e.* approximately 1 candela/sq. inch), is seen in a dark surround, it will cause some discomfort if it is bigger than about 10^{-4} steradians. Yet a total field of 500 footlamberts is quite comfortable (it is the luminance of an average overcast sky). In fact, if the size of the source is steadily increased from 10^{-4} steradians, the glare discomfort first increases, reaches a maximum, and then decreases until, when it covers the whole field, it is causing no discomfort whatever.

(1) If, therefore, we neglect boundary and position effects (but we cannot always do so) we would expect that the addition of small sources of 500 footlamberts luminance to increase discomfort *up to a point,* and then to reduce discomfort. Hence we can only assume simple additivity over a limited range.

(2) Now, if we consider a source of 20,000 footlamberts *(i.e.* about 40 candelas/sq. inch), we can establish that such a source causes distinct discomfort when seen in a dark surround, when its size is about 10^{-6} steradians. If such a source is increased in size, it becomes steadily more "uncomfortable" and no amount of adaptation time causes any amelioration. Hence we might expect that the addition of small sources of 20,000 footlamberts would produce a progressive increase in discomfort. Simple additivity might possibly be valid for such bright sources.

These two deductions are in accord with the experimental findings of the Petherbridge-Hopkinson (1950) investigation. The relation between the size of a source, its luminance and the degree of glare discomfort for conditions of zero field (surround) luminance has recently been determined at the Building Research Station but, since the relation needs many more observations from many more subjects to validate it, it is, I think, wiser to leave it in the laboratory files at the moment.

When the effect of a surround field is included, the situation becomes more complicated. But if we can look forward a little, we may find that:

(a) For the greater body of present-day lighting practice, the glare from a number of sources can be evaluated by the addition of the effects of the individual sources, on the basis of equivalent source area (Petherbridge and Hopkinson (1950)).

(b) For conditions involving the addition of large sources of low luminance, the glare effects of a number of such sources can be expected to be less than simple additivity of the individual effects would indicate.

(c) For conditions involving the addition of sources of high luminance, the glare effects of a number of sources will be greater, in some cases much greater, than simple additivity of the individual effects would indicate.

It would perhaps be unwise to go further than this at the moment. It may be useful, however, to report the results of two studies which are ancillary to the investigation. In one experiment, the aim was to simulate a situation similar to that of an installation consisting of a series of large laylight sources which taken together occupy a large part of the upper visual field. Five rectangular sources, arranged in a perspective pattern were employed, whose angular subtense varied from 0.0009 steradians for the smallest to 0.013 steradians for the largest. The angular subtense of the five sources together was 0.026 steradians. The smallest source lay 6° and the largest 14° above the direction of viewing.

Assessments of glare were made on two occasions by each of three experienced subjects, viewing each of the sources singly and in three combinations, *i.e.* sources 2 and 4 together; 1, 3 and 5 together; and all five sources together. The assessments demanded settings of surround luminance to give, in turn, the four B.R.S. criteria of glare at each of three source luminance levels (300, 1000, and 3000 footlamberts) with each source or combination of sources.

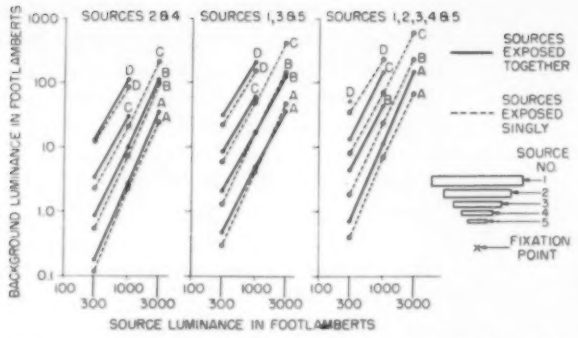

Figure 9 (above). Equal-glare curves showing additive effect/ glare from those combinations of sources.

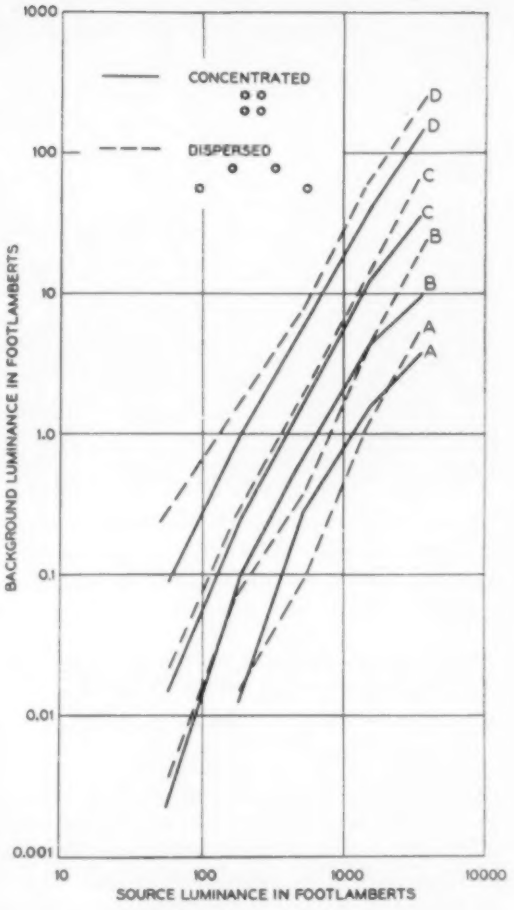

Figure 10 (right). Equal-glare curves for four small circular sources with concentrated and dispersal groupings.

The averaged surround luminance settings for individual sources were added together for each of the three combinations of sources studied and compared with the corresponding averaged settings actually obtained for the combination of sources. The results are shown in Fig. 9.

In general, under these particular conditions, the surround luminance needed to "balance out" the glare from a combination of sources is rather greater than that deduced by adding the luminances needed to balance out the glare from each individual source. This is, of course, the effect reported by Harrison from observations in actual installations.

These results show to some extent the errors that can occur of the assumption of simple additivity of "glare constants." The greatest error, when all five sources are considered, amounts to half the difference between "just uncomfortable" and "just acceptable."

Another study just completed has as its aim to see if the inhibition of one part of the retina by stimulation of an immediately adjacent part might have some bearing on the additive nature of glare sources grouped in close proximity. To check on this, appraisals were made of the relative discomfort produced by two groups of glare sources, one group having the sources concentrated together and the other having the sources relatively widely dispersed. (Fig. 10.) Twelve observers viewed each of the groups of sources and were asked to say which group appeared to be most glaring when the source and background luminances were set at twelve predetermined levels.

Of the 144 appraisals which were made, 53 indicated the concentrated grouping to be more glaring while 42 indicated the dispersed grouping to be more glaring. Forty-three appraisals gave no difference in the relative degrees of discomfort. An analysis of these results showed that the actual appraisals were not distributed significantly differently from a theoretical distribution which divided the appraisals equally between "concentrated more glaring than dispersed," "dispersed more glaring than concentrated" and "no difference in glare."

Three observers used the multiple criterion technique to determine equal-glare curves relating source and background luminances for the two groups of sources when the background luminance was made variable and the source luminance was set at five predetermined levels. The average curves for two sets of appraisals from each of the three observers all confirmed the previous finding that there was no significant difference in the relative degree of glare produced by the two groups of sources. (Fig. 10.)

The two studies therefore established that if any mutual inhibition arose with the concentrated grouping then it was not sufficiently great to be

detected by either of the two experimental techniques described above, under the conditions of the experiment.

Studies of this kind, though valuable pointers, do not enable a systematic modification in the "glare formula" to be made, although they do give a practical result which can be made use of in lighting design. It would evidently be wise, for example, to recommend a more than proportional increase in surround luminance if sources are added to an installation of the kind simulated by the experiment of Fig. 9. Such installations are more common in the U.S.A. than in Europe. Every effort should be made to continue the work in the form of a comprehensive study designed to reveal the missing features of the glare phenomenon, following the outline given earlier in this paper.

The final stage of this review is to summarize for you our present practice in evaluating glare.

We use our Glare Formula

$$G = \frac{B_s^{1.6} Q^{0.8}}{B_b^{1.0}} \qquad (3)$$

as our basic measure. Although we were responsible for the proposal to use the formula

$$G = \frac{B_s^2 Q}{B_b} \qquad (2)$$

at the C.I.E. at Zurich, and although we have gone to considerable trouble to evaluate the best values of Glare Constant G to enable the new formula to give a good fit to the actual observations, we prefer to use equation (3) until international agreement is obtained, because it accords more closely with our experimental findings.

For situations where the sources are small and of uniform luminance, no major difficulties arise. The apparent size of the source is worked out, or gauged by a "steradian gauge," to give Q, and its mean luminance taken as the B_s term. The value of B_b is taken as numerically equal, when expressed in footlamberts, to the illumination in footcandles on a plane perpendicular to the direction of viewing, excluding the direct illumination from the glare sources. The Position Index may be ignored, or it may be given the values of Luckiesh and Guth. The effect of the immediate surround is ignored for first-order appraisals, or is estimated empirically from the experimental data. The glare constants for each source are worked out separately, and added arithmetically to give the Glare Constant for the whole installation.

Thus the glare constants G', G'' etc. are calculated for each source separately, for the same background luminance B_b.

$$G' = \frac{f(B_s') \cdot f(Q')}{B_b}$$

$$G'' = \frac{f(B_s'') \cdot f(Q'')}{B_b}$$

Then the "glare constant" G for the whole installation would be given by:

$$G = \Sigma G' + G'' + G'' + \ldots\ldots$$

Although the "glare constants," which are related to the degree of glare discomfort, have been added, this does not amount to an addition of *sensations*. It is merely an addition of $[f \cdot (B_s) \cdot f \cdot (Q)]$ terms over the common denominator B_b, and is therefore an addition of stimuli.

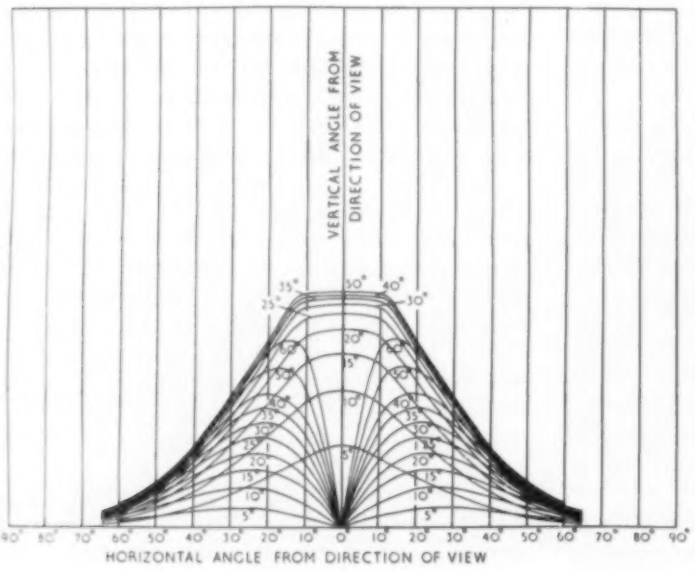

Figure 11. Petherbridge's projection for evaluating angular subtense of glare source, taking the Luckiesh-Guth Position Index into account. Droop lines are shown defining horizontal edges in planes at right angles and parallel to direction of view.

Figure 12. Luminance measurements are transferred to Petherbridge's diagram, and the combined source luminance, source size, and position factors determined together.

If the glare source is large or of irregular shape, it may be evaluated on a diagram which Petherbridge prepared, in which a cylindrical equal-area projection is modified to take into account the Luckiesh-Guth Position Index. (Fig. 11.) The diagram gives in one operation both the Q and the $f(\theta)$ terms in the Glare Formula (1). The normal droop-line diagram or a Sanson's net diagram can be used also to evaluate the average luminance B_b in a complex situation.

A vexed question arises in daylight studies or in artificial lighting by luminous ceilings or laylights, where the source luminance may be not much greater than the surround luminance. How is the adaptation term B_b to be evaluated?

It is not a question which has occupied much of my thought, for the reason that in those situations where it is important, the glare formula is known to break down. I am therefore more concerned to find a better relation between the variables than to find a modus operandi for the existing relation. In practice, in situations such as that shown, (Fig. 12), we decide by inspection. If the "source" occupies more than about a third of the field of view, we determine B_b as the average luminance of the whole environment including that of the "source." Otherwise it would probably be taken as the average of the environment excluding that of the source. In actual practical cases very little *significant* difference in the value of the Glare Constant results. If the Glare Constants obtained by one or the other system of evaluation differ substantially, it is almost certain that both are in error, and that the situation is one in which the glare formula is invalid *(i.e.* a situation where "saturation" effects are important, or where the exponent of the B_s term should be greater, and of the B_b term less than those of the formula, for reasons discussed earlier).

The glare constants so evaluated can then be

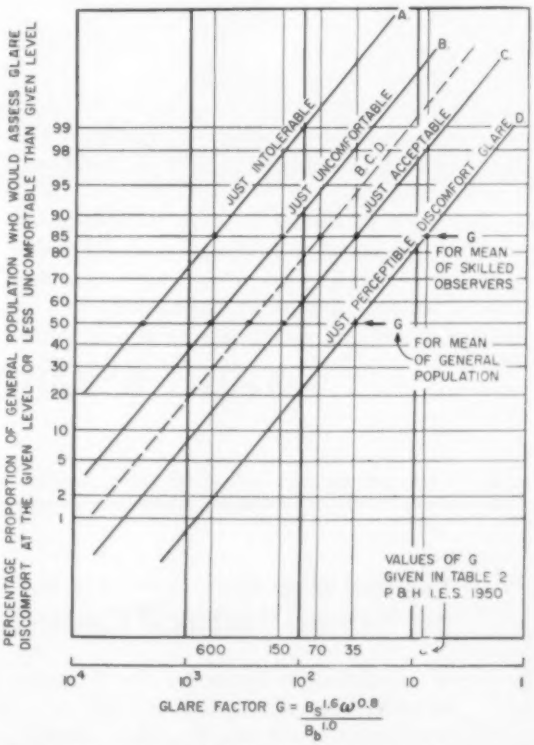

Figure 13. Mean probability diagram to enable proportion of general population satisfied by a given glare criterion to be related to the B.R.S. "Glare Factor."

examined on a mean probability diagram (Fig. 13). This diagram is derived from the results of the 50-observer study referred to earlier, but it is not a mathematical average of those results. It is based on the findings (a) that the means for the experienced six-man team on whose judgments the glare constants are based correspond to the 85 per cent probability level on the 50-observer study, and (b) that the mean judgment of glare for the general population in a given situation is one "criterion" less glaring than that of the six-man team.

With the aid of the diagram an estimate can be made of the percentage of the general population who will receive any given sensation of glare in the given situation whose glare constant has just been evaluated. The changes necessary to the glare constant to enable any given percentage of the general population (80 per cent was suggested to the C.I.E. as a reasonable figure) to achieve any given standard *(e.g.* the BCD) can thence be determined from the diagram. It so happens, quite by accident, that a Glare Constant of 100 from the B.R.S. formula enables 80 per cent of the general population to achieve the BCD or better.

Conclusion and Acknowledgments

The purpose of this review is to summarize ideas and work on glare discomfort at the Building Research Station, and to give a rather less formal presentation than customary in order that work could be discussed which is incomplete or which rests on insufficient evidence for a formal publication. There are many advantages in holding meetings at which ideas can be exchanged freely without the fear that adverse criticism must be anticipated by an array of cross-checks on all the results.

The end to which we are all working is to achieve a useful measure of international agreement on our findings, in order to promulgate an agreed method for the estimation of glare discomfort in practical lighting situations. It is clear that the problem, while simple at first glance, is riddled with second and third order complexities. A decision must be reached as to how far we can let these complexities hold up our agreement. The matter is urgent, because, certainly in Britain, if the experts do not agree, the engineers will go ahead themselves, as to a large extent they already have done.

In making this informal presentation of the work, I have committed myself perhaps further than I could in a formal paper from the Building Research Station, but I acknowledge the permission of the Director of Building Research to present the paper, though I cannot commit the Station in any way to the personal opinions I have expressed. I also acknowledge the help of my colleagues in these studies, especially Mr. Petherbridge who has been associated throughout with the Building Research Station work, and Mr. S. J. Richards and Miss W. M. Godfrey who have shared the work at different stages.

Finally I would like to thank the Illuminating Engineering Research Institute, Mr. C. L. Crouch and Professor E. M. Strong, for affording me the opportunity to attend the Cornell Symposium and present the paper.

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INSTALLATION AT HARTZEL BROTHERS, 225 BRIGHTON AVE., ROCHESTER, PA.

Lighting a Furniture Store

LIGHTING OBJECTIVE: To provide general illumination in an attractive manner for the display and sale of furniture.

GENERAL INFORMATION: The display and sales area shown above is approximately 42 by 42 feet. The height from floor to acoustic tile and plastic ceiling sections is 8 feet. Color and reflectances of the room surfaces are as follows:

ceiling		
cavity above plastic	white	75% RF
acoustical tile	gray	48% RF
walls	light green	60% RF
columns	light green	60% RF
floor	brown & gray	10% RF

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INSTALLATION: An average of 55 footcandles of general illumination was provided 500 hours after luminaire cleaning by ten Marco catalogue No. J1-96(c) recessed incandescent units and three Guth Gratelite ceiling sections, two measuring 8 by 32 feet and one measuring 8 by 40 feet. Continuous rows of Guth catalogue No. M-5302 units, each equipped with one 40-watt T-12 standard cool white fluorescent lamp, are spaced on 2-foot centers 14 inches above the Gratelite ceiling sections. The Marco recessed units are each equipped with one 100-watt inside frosted incandescent filament lamp and are spaced on 8-foot centers in two rows 14 feet apart.

Brightnesses at the time of illumination readings were as follows:

recessed incandescent luminaire at 45°	1200 ft-L
ceiling	
plastic sections at 45°	120 ft-L
acoustical tile	10 ft-L
walls	40 ft-L
columns	35 ft-L
floor	5 ft-L

Lighting designed by C. P. O'Brien, Duquesne Light Co., Pittsburgh, Pa.; lighting installed by Schmidt Electric Co., Rochester, Pa.

Lighting data submitted by Armand Zitelli, Duquesne Light Co., Pittsburgh, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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A Photoelectric Telephotometer of High Sensitivity and High Angular Selectivity

By FRANK F. CRANDELL
KARL FREUND

An increasing number of problems today require photometric measurements on smaller and smaller objects, at lower and lower light levels. The present paper describes a commercial instrument designed to meet these needs.

For illustration, we can consider some of the problems that arise in night-time street lighting. Ideally, one would like to have an instrument capable of making quick quantitative brightness measurements of anything the human eye can see in a street scene: pavement surface, pavement markings, portions of silhouetted obstacles, reflections from shiny objects, lamp glare and even the lettering on signs. Some of the angles of interest are surprisingly small, and the surface brightnesses are low compared with those commonly encountered in applications where portable photometers are ordinarily employed. The letters and markings on a highway sign, for example, are often less than an inch in thickness and frequently have a surface brightness less than 0.1 footlambert under night-time conditions. At a distance of 300 feet, a one-inch mark on a street sign subtends less than a minute of arc. A pavement marking, such as the line defining a pedestrian crosswalk, at right angles to the line of traffic, may be four inches broad, but it subtends only half a minute of arc when viewed from the driver's seat of an automobile at a distance of 150 feet.

The instrument described was developed specifically to facilitate work on problems related to night-time street lighting, but other applications may occur to the reader.

Fig. 1 is a schematic diagram of the telephotometer. It is essentially a Cassegrain reflecting telescope. Light from a distant object is received by the primary mirror, which is a concave f/4 ellipsoid 6 inches in diameter, and is reflected to a convex spherical secondary mirror, which converts the beam to f/16 and puts the final focus about 3 inches behind a hole in the center of the primary mirror. In this way, one obtains a large aperture and a convenient magnification with an optical system of light weight and modest cost. The telescope can be focused over a range from 70 feet to infinity by moving the Cassegrain secondary mirror in and out along the axis. For convenience of operation, this is accomplished with a simple electrical push-button control.

The effective focal length of the system is 96 inches, and the unvignetted field of view at the focal plane is roughly 1 inch in diameter, or 0.6 degree. The scale of the image is 1.4 minutes of arc per millimeter or 36 minutes of arc per inch. An auxiliary finding telescope, similar to a telescopic gunsight, is attached to the side of the instrument to facilitate initial aiming; a parallax and focus corrector for it are under development.

In order that areas or spots of suitable size in the field can be isolated for measurement, a series of focal-plane diaphragms is provided on an accurately made disk having a snug bearing and positive locking detents. The dimensions of the diaphragms are listed in Table I. Their angular fields range from roughly one-half degree down to one-third minute of arc, or from 10 mils down to 0.1 mil. One mil is one-thousandth of a radian; it amounts, for example, to a field of one foot at a distance of 1000 feet. The aperture of largest size includes nearly the full unvignetted field of the telescope and is supplied with cross wires to aid in centering objects for measurement through the smaller diaphragms.

Each diaphragm is mounted on an adjustable block anchored to the disk by an array of adjusting screws which permit it to be centered with precision and secured in place. In this way, the diaphragms can all be pre-centered so as to be in registration with the cross wires and with one another as the disk is turned from each detent position to the next. A small and distant spot selected for measurement need only be centered and focused on the

Authors: Mr. Crandell, Chief Engineer; Mr. Freund, President, Photo Research Corp., Hollywood, Calif.

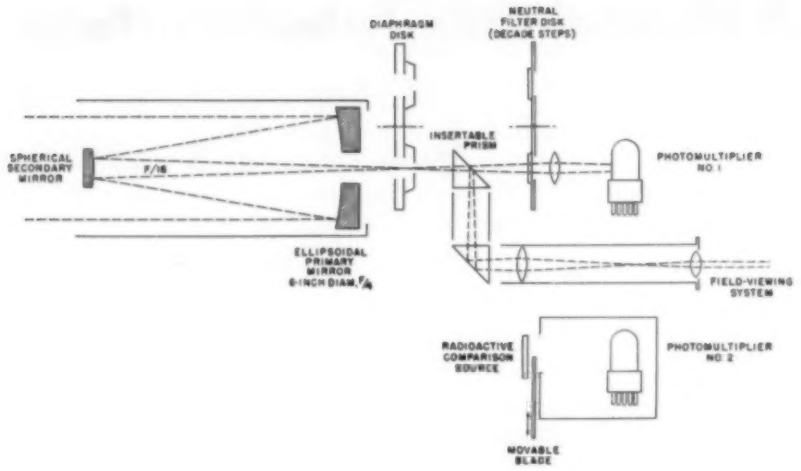

Figure 1. Schematic diagram of the telephotometer.

cross wires; it can then be measured instantly through any desired diaphragm without re-aligning the instrument. Table I also lists the range of brightnesses which can be observed through each of the diaphragms. The overall range extends from 0.00001 footlambert, to 1,000,000 footlamberts, which is a factor of 100 billion. The accuracy over most of the range, say over a factor of several billion, is about 10 per cent. Color filters are used for correcting the phototube color response to approximately that of the human eye. Errors arising from imperfect color correction should be of the same order of magnitude as variations among human observers.

Just behind the diaphragm disk is a rotatable arm carrying a pair of 45-degree prisms. When these prisms are inserted into the beam coming through the diaphragm, they reflect the image out through a field-viewing eyepiece. In addition to seeing the field and the cross wires, the operator can also observe the image directly through any desired diaphragm. This simplifies the problem of selecting the diaphragm of optimum size for isolating the spot or object of interest.

When the rotating arm is moved aside, the beam passes on through an attenuating filter and is received by a field lens in front of a photomultiplier tube. The field lens forms an image of the exit pupil of the telescope on the photocathode; this has the effect of preserving a constant distribution of light on the photocathode; *i.e.*, the distribution is independent of the pattern of illumination in the diaphragm plane. The instrument thereby measures a true average of the surface brightness within the diaphragm regardless of whether it is uniformly distributed.

There are six attentuating filters which provide decade steps in sensitivity from 1 to 100,000. These are mounted on a nine-position disk having suitable detents, and having an opaque section at every third position which be used for "zeroing" the photometer circuit. Since the sensitivity steps are provided by a series of filters instead of by a series of load resistors following the photomultiplier tube, the photoelectric signal level producing a full-scale reading is the same on all ranges. This feature makes it convenient to use a comparison source and a null-setting technique which is relatively independent of variations in power-supply voltages and ambient conditions.

The comparison source is a sealed plastic plaque containing some phosphor mixed with a small amount of a radioactive salt to make it glow. Although very faint by ordinary standards, a source of this kind is more than adequate for the present purpose. It also maintains its output for many

TABLE I — Focal-Plane Diaphragms.

Diaphragm Number	Diameter (Inches)	Angular Field (Min. of Arc)	Angular Field (Feet at 1000 Feet)	Minimum Brightness Detectable	Maximum Brightness Measurable
1	0.96	34.3	10.0	0.00001 ft-L	100 ft-L
2	0.30	10.8	3.2	0.0001	1,000
3	0.096	3.43	1.0	0.001	10,000
4	0.030	1.08	0.32	0.01	100,000
5	0.0096	0.34	0.10	0.1	1,000,000

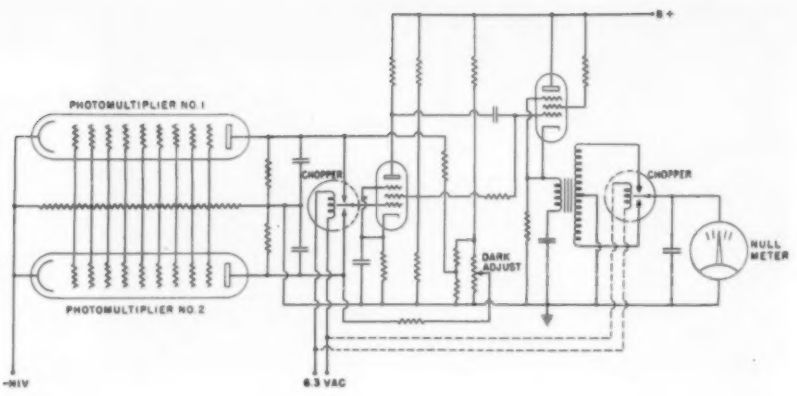

Figure 2. Circuit diagram of the null-detecting system.

years and requires no external power. Just in front of the phosphor is a mask with a window whose size is varied by a movable blade in order to control the amount of light reaching a photomultiplier tube. This is not the same photomultiplier that receives light coming through the telescope, but it is powered from the same source of high voltage. In other words, there are two photomultipliers, one receiving light through the telescope and the other receiving light from the phosphor. When using the instrument, the operator simply varies the area of the window in front of the phosphor until the signal outputs of the two photomultipliers match. After a null setting has been achieved, the surface brightness of the object being measured can be read directly in footlamberts on a calibrated knob which controls the area of the window in front of the phosphor. The various sizes of focal-plane diaphragms and various neutral filters merely shift the decimal point.

Fig. 2 is a circuit diagram of the null-detecting system. The power supply and the high-voltage supply are not shown. The outputs of the two photomultipliers are fed to opposite sides of a 60-cycle chopper with gold contacts. Any difference in the photomultiplier outputs appears as an a-c signal on the grid of the first pentode. After this signal has been amplified, it comes out through an audio transformer and is synchronously rectified by another pole of the 60-cycle chopper. The sign of the resulting d-c output, which is fed to a zero-center meter, indicates the direction of unbalance,

Figure 3 (above). Telephotometer being aimed and focused by an operator. The field-viewing eyepiece at the left is associated with the main optical system. The small black telescope at the right is the auxiliary view finder.

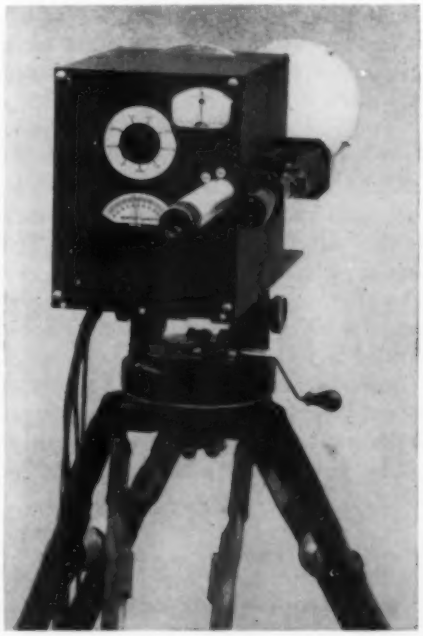

Figure 4 (right). View of the instrument panel. In the upper right corner is the null-indicating meter. At the left is the decade attenuator (neutral filter disk) and below it is the comparison-source control. The upper rim of the diaphragm disk sticks out of the top of the instrument.

Figure 5. Night-time street scene where the sample measurements listed in Table II were obtained.

TABLE II — Surface Brightnesses of Objects in Fig. 5.

	Identification	Angular Field in Mils (Feet at 1000 Feet)	Brightness (Footlamberts)
A	Wall	1.0	0.026
B	Parking Sign	1.0	0.040
C	Roof of House	3.2	0.010
D	Bright part of wall	1.0	0.26
E	Shadow on wall	1.0	0.13
F	Left stripe of double line	1.0	0.026
G	Right stripe of double line	1.0	0.030
H	Cement pavement surface	1.0	0.009
I	"Neon" tube (green) in letter "P"	0.1	220.
J	Sky	10.0	0.030
K	Brightest spot on luminaire	0.1	3000.
L	Faintest spot on same panel	0.1	19.
M	Panel on unlit luminaire	0.32	0.40
N	Vertical face of curb	0.1	0.023
O	Post of parking sign	0.32	0.095
P	Doorway in shadow	1.0	0.002
Q	Wall	1.0	0.040

that is, it indicates which photomultiplier output is the stronger at that instant. When the window in front of the phosphor is closed and the filter disk is set on "dark," the thermionic currents of the photomultipliers can be balanced out with the "dark-adjust" potentiometer. No other adjustment or calibration is required before brightness readings are made.

Two views of a pilot model of the complete instrument mounted on a tripod are shown in Figs. 3 and 4. The instrument is 32 inches long with a principal cross-section of 8 x 10 inches, and it weighs approximately 30 pounds. The tripod is equipped with worm-gear motions in azimuth and elevation. A mechanism for measuring these angles and for moving the instrument in accurately calibrated increments is under development. The associated electronic units are in a separate box which is not shown. Although the system operates on 110 volts a-c, the power requirements are low enough to be provided by a compact portable or mobile source, such as a d-c-a-c converter connected to an automobile battery.

Let us now return to the photometric problems for which this instrument was designed. There are two general methods of specifying the minimum requirements in lighting: they can be stated (1) in terms of incident illumination or (2) in terms of the resulting surface brightness. While the former is perhaps the simpler to measure, the latter is what really matters.

In night-time street lighting, for example, it is common practice to specify the minimum incident illumination on a horizontal test surface. On a well-lit street the average level might typically be in the vicinity of one horizontal footcandle, with local variations ranging from several times lower to several times higher. However, as already pointed out by Finch,[1] we are really interested in the visibility of objects, which depends upon their relative surface brightnesses, sizes, and contrasts. The basic instrument needed for investigating street lighting is therefore a sensitive telephotometer capable of measuring the brightness of anything in a street scene the human eye can see.

Fig. 5 shows a typical night-time street scene. The photographic exposure was 2 minutes at f/11 on Royal Pan film. Some objects of interest are identified by letters. The surface brightnesses of these are listed in Table II to illustrate the orders of magnitude encountered. The angular diameters of the diaphragms used are given in mils. All measurements were made with the telephotometer placed at motorist-eye-level, at the same location as the camera.

1. Finch, D. M.: "Some Factors Influencing the Night Visibility of Roadway Obstacles," ILLUMINATING ENGINEERING, Vol. LII, No. 3 (1957).

INSTALLATION AT B. F. DEWEES, INC., 1122 CHESTNUT ST., PHILADELPHIA, PA.

Lighting a Women's Apparel Store

LIGHTING OBJECTIVE: To provide general and supplementary illumination for the display and sale of women's apparel.

GENERAL INFORMATION: The area shown above measures approximately 20 by 130 feet and has a ceiling height of 15 feet. Colors and reflectances of the major surfaces are as follows:

ceiling	beige	41% RF
walls		
above valance	beige	41% RF
below valance	egg-shell	50% RF
floor	brown and white	40% RF
display cases	limed oak	41% RF

INSTALLATION: General illumination is provided by eight surface mounted fluorescent luminaires (Smithcraft catalogue No. 10496), each equipped with four 96-inch T-12 deluxe cool white slimline fluorescent lamps, and by fifty-five surface mounted incandescent luminaires (Litecraft

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catalogue No. H604, with Miroflector 150-watt size reflector and clip-on louver) each equipped with one 150-watt A-23 clear lamp. The fluorescent units are spaced on 16-foot centers, in the middle of the ceiling. The incandescent units are spaced on 5-foot centers, 4 feet out from the wall.

Floor cases are illuminated by 25-watt T-10 clear incandescent showcase lamps spaced longitudinally on 12-inch centers. Wall cases are illuminated by 40-watt T-12 deluxe cool white fluorescent lamps. Decorative valance lighting is provided by continuous rows of 20 mm white cold-cathode fluorescent lamps.

Average illumination levels of 60 footcandles on the counters and 20 footcandles through the center of the store were provided by the ceiling lighting system. Brightnesses at that time were as follows:

luminaires	
fluorescent at 45° lengthwise	290 ft-L
at 45° crosswise	400 ft-L
incandescent at 45°	110 ft-L
ceiling	3 ft-L
walls	
above valance	6 ft-L
below valance	9 ft-L
floor	7 ft-L
display cases	4 ft-L

Lighting designed by George T. Anderson, Jr., Philadelphia Electric Co., Philadelphia, Pa. Electrical Contractor, Independent Wiring Co., Philadelphia, Pa.

Lighting data submitted by George T. Anderson, Jr., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Lighting Traffic Tunnels And Underpasses

Prepared by Subcommittee on Tunnel and Underpass Lighting of the Street and Highway Committee of the Illuminating Engineering Society

Preface

The ensuing recommendations have resulted from a recognized need for more helpful information and guidance to engineers and agencies dealing with the construction and illumination of traffic tunnels and underpasses. The need is especially apparent for effective *daytime* treatment of the entrance sections of tunnels and long underpasses to eliminate, or minimize, hazardous visibility to entering vehicular traffic.

The Subcommittee on Tunnel and Underpass Lighting of the Street and Highway Committee has formulated these recommendations as an interim report subject to subsequent modifications as warranted by further research and experience. The Committee believes that there is sufficient practical substantiated information outlined in this report to justify releasing to the industry immediately. At some future date a more conclusive report may receive the approval of the American Standards Association.

The content of this report has been approved by a majority of both the Subcommittee and of the full Street and Highway Committee.

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Approved by the Council of the Illuminating Engineering Society, February 1957.

1. Introduction

1.1—*General*— **(a)** The constantly increasing number of vehicular traffic tunnels and long underpasses in the United States, plus heavier traffic flow, at higher average speeds, renders the problem of adequate protective visibility in these tunnels one of paramount importance. Such tunnels involve special design features not common to streets and highways. For this reason, lighting by the conventional lighting methods and equipment may not be satisfactory.

(b) In this report the word "tunnels" is used as applying to passageways 1000 feet or more in length; "underpasses" are less than 1000 feet long.

1.2—*Basic Objectives in Tunnel and Underpass Illumination*— All factors which may improve visibility and comfortable usability must be considered in designing tunnels and underpasses and their lighting systems. Brightness (and therefore illumination levels and reflectance) of ceiling and sidewalls may be of equal, or greater importance than roadway illumination. The following fundamental objectives are common to a majority of vehicular traffic tunnels in this country, and may

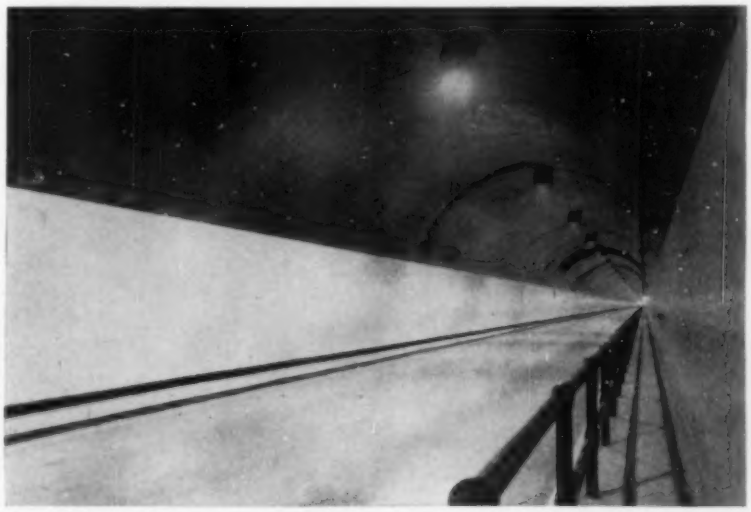

Figure 1. Liberty Tunnel, Pittsburgh, Pennsylvania, is lighted by enclosed-type luminaires with 10,000-lumen sodium lamps spaced 50 feet apart; pavement is 21 feet wide.

Figure 2. Holland Tunnel, New York, New York (similar to Detroit-Windsor and Sumner-Boston Tunnels), is lighted by 150-watt filament lamps in flush-type luminaires on 20-foot linear and opposite spacing; pavement is 21.6 feet wide.

assist in both analyzing illumination requirements incident to any given tunnel and in arriving at the most effective solution to the lighting problem.

1.2.1—*Adequate, Comfortable Driver Visibility Both by Day and at Night*— Such major influencing factors as tunnel or underpass length, cross-section dimensions, nature of tunnel lining, traffic volume, urban or inter-urban location, and outside field-of-view brightness immediately adjacent to the portal should be carefully considered when designing the lighting system.

1.2.2—*Quality and Design of Illumination Which Will Minimize Driver Apprehension and Uncertainty* — Attention to this objective will be reflected in increased safety and comfort.

1.2.3—*Elimination of Distracting and Uncomfortable Flickering Highlights and Shadows* — The fulfilling of this objective is an important adjunct in accomplishing the foregoing two objectives. Illumination should be comfortable to the motorist and possible pedestrian, as well as adequate for effective seeing.

1.2.4—*Satisfactory Eye Adaptation of Motorists Entering during the Daytime, Especially under Bright Sunlight Conditions* — The achieving of this most important objective is largely a matter of (1) relating field-of-view brightness inside the tunnel or underpass to that outside the portal and (2) allowing the eye sufficient time (by the length of the higher-level illuminated entrance section) to become effectively adjusted to the lower brightness level inside.

1.2.5—*Dependability of the Lighting System* — Steps should be taken to safeguard traffic effectively against a sudden "blackout" of the lighting system and, thus, avoid possible serious accident and driver hysteria consequences.

1.2.6—*Reasonable Initial and Maintenance Costs* — A judicious selection of lamps, luminaires and circuiting usually will assure desired economy in installation and maintenance. In longer tunnels, effective ventilation constitutes a positive factor toward maintaining cleaner luminaire equipment. This is particularly significant where lamps and reflector surfaces are exposed to the tunnel air.

1.2.7—*Ease and Safety in Maintaining the Lighting System — Plus Minimum Interference with Traffic Flow* — The types of lamp, luminaire and circuit, plus the location of the luminaires, are major factors influencing the achieving of these objectives.

1.3—***Atmospheric Requirements for Lighting Equipment*** — Traffic tunnels and underpasses impose, essentially, outdoor weather and temperature conditions upon the luminaire and lamp equipment used in the lighting system. Consequently, durability and weather-resistant qualities in such equipment should receive careful attention.

Figure 3. Lake Way Tunnels, Seattle, Washington, are lighted by 20,000-lumen mercury lamps spaced approximately 40 feet apart; pavement width is 23.5 feet. Luminaires in the entrance section shown here are spaced much closer (7 to 30 feet) for higher-level daytime entrance illumination.

2. Tunnels with Constantly-Energized Circuits (Night and Normal-Day-Zone Lighting)

2.1—***Recommended Illumination Levels*** — **(a)** Based on experience accumulated from scores of tunnel lighting projects both here and abroad, some described in Appendix A,

Table I of illumination values has been prepared as a guide for use in future designs.

(b) Circuits affording variable illumination levels are used in some recent installations, thus providing illumination compensation for differences in daylight levels, traffic volume and ambient temperature.

(c) At night, eye adaptation in entering and leaving a tunnel usually is aided by lighting a 500- to 600-foot section of the approach roadway to a level of approximately 50 per cent of the average illuminatnon inside the tunnel. Fig. 8 illustrates this practice.

2.2—*Brightness*—Well distributed sidewall, ceiling and pavement brightness, against which vehicles and obstructions are seen, is *essential* in assuring satisfactory driver visibility and comfort. It is desirable that the ceiling be lighted to not less than ⅓ the average brightness of the walls. It is recommended that the ratio of *brightness variation* on the sidewall and the ceiling (maximum to minimum footlamberts) not exceed 15 to 1.

2.3—*Reflectance*— A light color matte (non-specular) finish on sidewalls and ceiling surfaces is conducive to optimum visibility and comfort. The reflectance should be 70 per cent, or higher. The frequent use of a washing truck, incorporating a pressure detergent spray and revolving brushes, seems essential in maintaining the ini-

TABLE I — Recommended Minimum Average "Maintained in Service" Illumination Levels.

Traffic Condition*	Night and Normal-Day-Zone (Beyond Entrance Section)		
	Reflectance of Ceiling & Wall	Minimum Avg. Footcandles	Minimum Avg. Footlamberts
HEAVY (1200 and above) with well-lighted approaches	70%	5	3.5
	60%	6	3.6
	40%	9	3.6
LIGHT TO MEDIUM (150 to 1200) with minimum approach lighting	70%	4.5	3.0
	60%	5	3.0
	40%	7.5	3.0

*Maximum night hour traffic, both directions.

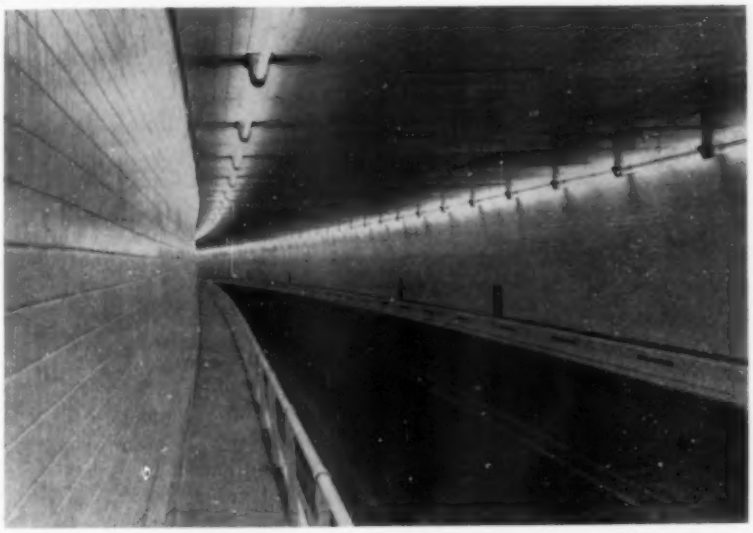

Figure 4. Brooklyn Battery Tunnel, New York, New York, is lighted by two continuous lines of 72-inch T-8 slimline fluorescent lamps enclosed by Pyrex glass sleeves, and mounted from the ceiling by special porcelain brackets. The lamps are energized by variable-current series circuits from saturable-core reactors, giving a 50 to 120 ma current range. Pavement width is 21 feet.

Figure 5. Liberty Tunnel, Pittsburgh, Pennsylvania, entrance as seen in bright sunlight, *before* installation of supplementary daytime entrance lighting.

Figure 6. Liberty Tunnel, Pittsburgh, Pennsylvania, entrance area *after* installation of floodlights, equipped with incandescent filament lamps for supplementary daytime entrance lighting.

Figure 7. McCallie Tunnel, Chattanooga, Tennessee, lighted by T-8 slimline fluorescent lamps in enclosed-type luminaires. The illumination level is graduated downward over an approximate distance of 300 feet in from the portal.

Figure 8. Illumination of approach roadway, to 50 per cent of illumination inside the tunnel, aids in eye adaptation in entering and leaving a tunnel at night.

tial light-reflecting effectiveness of such surfaces.

2.4—*Lighting Equipment* — The lighting equipment should have a distribution such as to direct light onto the ceiling and side walls in a relatively uniform coverage, so that the ratio of brightness variation on each does not exceed 15 to 1 (see Section 2.2). There should be a minimum of objectionable brightness toward the eye of the motorist or pedestrian.

3. Daytime Tunnel Entrance Lighting

3.1—*General* — For *daytime* operation, the entrances should have a supplementary lighting system. The purpose of supplementary lighting is to avoid an abrupt change between the several thousand footcandles of daylight, and the few footcandles in the tunnel. Such an abrupt change temporarily reduces the motorist's ability to see to a hazardous degree, until his eyes have become adapted.

3.2—*Ratio of Outside-to-Inside Brightness* — **(a)** A maximum difference of 15 to 1 in outside-to-inside field-of-view brightness now appears desirable, particularly with 15-foot portal heights and entering speeds in excess of 30 mph. The normal eye is able to adapt to this brightness range within the space of 2 to 3 seconds, without a hazardous and disturbing loss of visibility.*

(b) A typical installation might be one with 4000 footcandles of daylight outside the portal, a 20 per cent average reflectance of the outside portal area and a 70 per cent reflectance of the tunnel lining. In this example the *outside* portal brightness would be 4000×0.2 or 800 footlamberts. Therefore, the desirable *inside* brightness is $800 \div 15$ or 53 footlamberts. This would be obtained with an illumination of $53 \div 0.7$ or 76 footcandles directed on the inside surfaces. Lower brightness levels *outside* the portals permit correspondingly lower brightness levels inside. However, a lower *reflectance* than the above 70 per cent for inside areas would require a higher footcandle level. See Table II.

3.3—*Length of Entrance Requiring High-Level Illumination** — **(a)** The average eye requires a minimum of 10 seconds time to adapt effectively from the high outside brightness to the low brightness inside the

*Subsequent studies and research may justify modifying this advised 15 to 1 (outside to inside) brightness ratio to, say, 20-30 to 1; especially in instances of slower entering speeds coupled with reduced outside brightness, and portal heights substantially more than 15 feet.

*The Subcommittee recommends the indicated eye-adapting time with resulting daytime entrance lengths. Certain recent findings point to the possibility of adopting somewhat shorter sections of daytime entrance lighting. See "A New Approach to Highway Tunnel Lighting" by Brass, Skootsky and Trosper, ILLUMINATING ENGINEERING, March 1957.

TABLE II — Recommended Day Time Entrance Lighting for Traffic Tunnels (Maintained in Service). 15 Ft. Portal Height Assumed.

Time	Distance in Ft. from Portal at 30 mph	Distance in Ft. from Portal at 60 mph	Reflectance of Walls & Ceiling	Min. Avg. Ft-c at 30 mph	Min. Avg. Ft-c at 60 mph	Min. Avg. Ft-L at 30 mph	Min. Avg. Ft-L at 60 mph
1st 5 Sec.	0-225	0-450	70%	50	75	35	50
			60	60	85	35	50
			40	85	125	35	50
2nd 5 Sec.	225-450	450-900	70%	30	50	20	35
			60	35	60	20	35
			40	50	85	20	35
3rd 5 Sec.	450-675	900-1350	70%	10	30	7	20
			60	12	35	7	20
			40	18	50	7	20

NOTE: This tabulation indicates higher advised illumination levels for tunnel lining reflectances which are lower than 70%, namely, 60% and 40%.

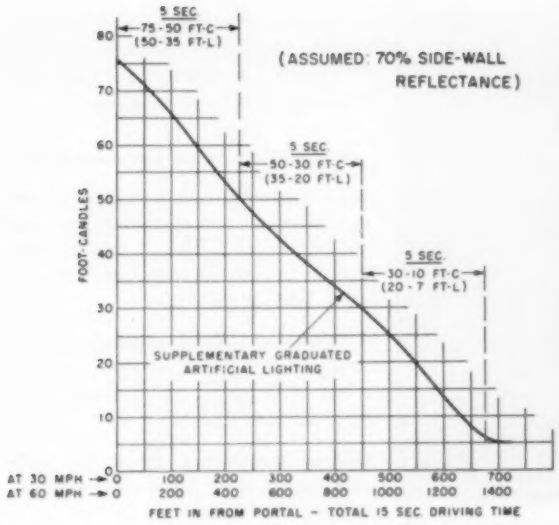

Figure 9. Recommended daytime entrance lighting for traffic tunnels. Graphs based on assumed speeds of 30 and 60 miles per hour and a 70 per cent side-wall reflectance.

Figure 10. An example of the need for *reduced* brightness of the *outside* portal area, and *increased* brightness immediately *inside* the portal.

tunnel. (A normal eye doubles the pupil size in approximately 10 seconds when required to suddenly adapt from extremely high to low brightness levels.) At a 30-mile-per-hour entering speed, approximately 450 feet will be travelled in 10 seconds. This should be the *minimum length* of the supplementary entrance section lighted. A 15-second eye adaptation time is recommended for *added* driver safety and comfort. This would require approximately 675 feet, at 30 miles per hour, and 1350 feet at 60 miles per hour.

(b) It is recognized that entering speeds up to 60 miles per hour may prevail at some highway tunnels. Fig. 9 and Table II cover this speed variation.

(c) Fig. 9 and Table II also show a typical example of advised daytime tunnel entrance illumination levels. Assuming a 15-second adaptation interval and traffic moving at 30 and 60 miles per hour, 675 feet (at 30 mph) and 1350 feet (at 60 mph) inside the entrance should receive supplementary lighting. Assuming 4000 footcandles outside the tunnel and the outside and inside reflectances listed in Section 3.2 (b), an illumination level of 76 footcandles is required on the tunnel lining immediately inside the portal to assure effective entering visibility.

(d) Fig. 9 also shows how the illumination should be gradually decreased along the 15-second section, to the continuous illumination level prevailing throughout the remaining length.

(e) Portal-entering visibility is appreciably enhanced by emphasizing sidewall and ceiling brightness, rather than by a concentration of light downward upon only the vehicular pavement.

3.4—*Additional Recommendations for Improving Daytime Entrance Visibility*— (a) Reduce brightness of areas immediately outside the portal by applying a low reflectance finish to the face of the portal, by providing a dark vehicular pavement surface for a distance of 500 feet out from the portal, and possibly by providing heavy tree foliage, shading the roadway and portal areas. The need for reduced brightness of the outside portal area, plus the importance of increased brightness immediately inside the portal, is shown in Fig. 10. Supplementary traffic marking and

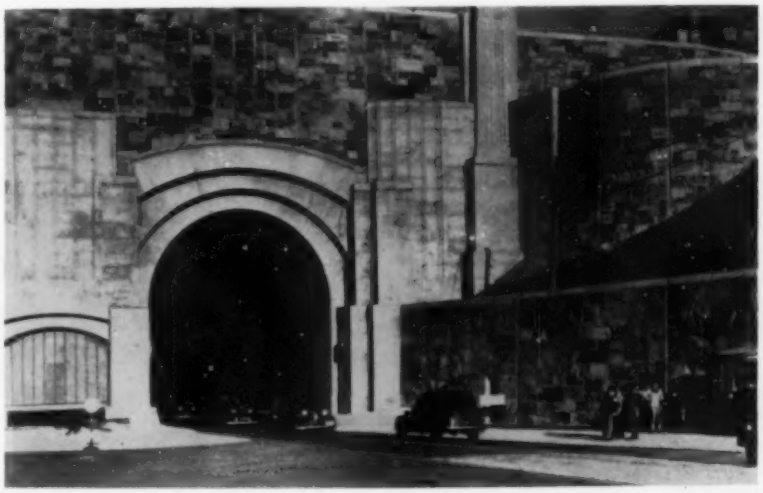

Figure 11. Lincoln Tunnel, New York, New York, is an example of funnelled-up ceiling height at the portal, to permit more effective daylight penetration.

Figure 12. Entrance section of traffic tunnel through the Croix-Rousse Mountain near Lyons, France. The main tunnel illumination is provided by 40-watt fluorescent lamps spaced 12.8 feet apart along the walls, with additional illumination at each entrance section provided by 150-watt fluorescent lamps in ceiling panels. This provides a graduated level of from 100 to approximately 10 footcandles over an approximate distance of 500 feet in from the portal. Daylight levels outside largely determine the illumination level used inside the portal.

directing devices may be needed for safe and convenient night driving.

(b) Funnel-up ceiling height, at the portal, to permit more effective daylight penetration. (See Fig. 11.)

(c) Arrange entire daytime *entrance section* illumination in *two* levels; the higher for bright sunlight outside, and the lower for dull, cloudy conditions.

(d) Definitely contrasting colors on curbs and on the pavement center-line (in the event of two-way traffic) increase driver assurance and comfort.

(e) Increased illumination, or brightness levels, usually are not required at tunnel exit sections because eye adaptation in going from dark to brighter surrounding is much faster than in going from bright, to dark. Under extremely high outside brightness levels, however, some increase in exit section illumination may be required.

4. Continuity of Illumination

4.1—*General* — The following recommendations and suggestions are advanced to assist in safeguarding against a serious "blackout" of the main lighting system.

4.2—*Group Replacement*—Lamp outages, caused by burnouts, can be minimized by a group-replacement maintenance schedule.

4.3—*Emergency Battery-Operated Lighting Circuits* — In instances where only one power source is available, a separate low-level emergency lighting system often constitutes an effective and merited provision. Such circuits are battery-energized, with an automatic throw-over switch operating instantly at the failure of the main lighting system. At best, such stand-by emergency lighting affords minimum visibility for reasonably safe traffic exit from the tunnel, at greatly reduced speeds. The emergency circuit, also, may actuate a warning signal to outside traffic approaching an entrance portal.

4.3.1—*Alternate Lamps* — Alternate lamps, or groups of lamps, may be staggered on two or more independent sources of power. This practice probably constitutes the most commonly used safeguard against a total "blackout."

Figure 13. Underpass in Sacramento, California, illuminated by 10,000-lumen sodium lamp street lighting luminaires positioned at each end of the underpass.

5. Underpass Lighting

5.1—*General* — **(a)** The amount of supplementary illumination required in an underpass, in which some light is provided by the street lighting units outside, depends on such factors as underpass length, ceiling height, interior finish of walls and ceiling, vehicular and pedestrian traffic volume, degree of roadway illumination adjacent to underpass, speed of vehicular traffic and proximity of hazardous obstructions.

(b) Since length is judged to be one of the most influential single factors relative to lighting problems involved, the following recommendations and suggestions are based on three different typical lengths. A ceiling height of 14 to 15 feet is assumed.

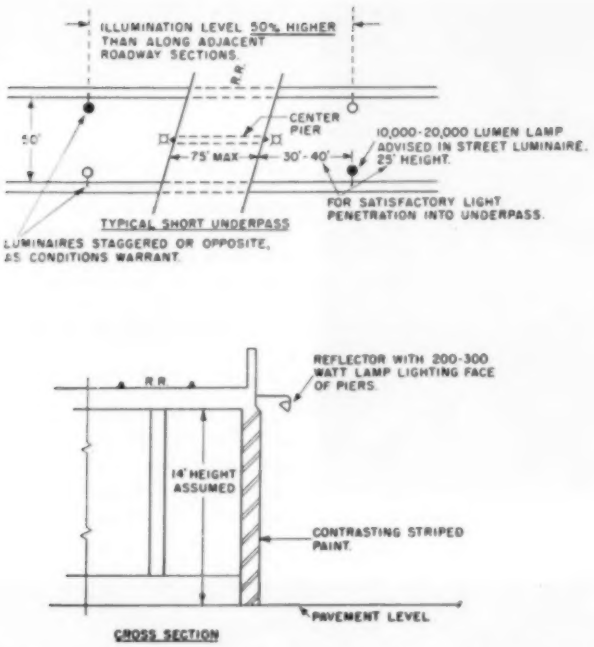
ILLUMINATION LEVEL 50% HIGHER THAN ALONG ADJACENT ROADWAY SECTIONS.
CENTER PIER
10,000-20,000 LUMEN LAMP ADVISED IN STREET LUMINAIRE. 25' HEIGHT.
50'
75' MAX
30'-40'
FOR SATISFACTORY LIGHT PENETRATION INTO UNDERPASS.
TYPICAL SHORT UNDERPASS
LUMINAIRES STAGGERED OR OPPOSITE, AS CONDITIONS WARRANT.
REFLECTOR WITH 200-300 WATT LAMP LIGHTING FACE OF PIERS.
R.R.
14' HEIGHT ASSUMED
CONTRASTING STRIPED PAINT.
PAVEMENT LEVEL
CROSS SECTION

Figure 14. Recommended treatment of a typical short underpass located on a main traffic street.

5.2—*Short Underpasses (Less Than 75 Feet in Length)*—(a) In a majority of instances no lighting system is required inside these underpasses. By *day*, adequate daylight penetration from each end generally assures effective and comfortable visibility.

(b) At *night*, the proper positioning of pole-mounted street lights adjacent to each end of the underpass usually provides satisfactory visibility to both vehicular and pedestrian traffic. These street lights should be located on the left-hand curb as traffic approaches the underpass for maximum pavement brightness and overall visibility, assuming a staggered arrangement of luminaires. On well-lighted roadways an opposite arrangement of street lighting luminaires at each end of the underpass may be merited to assure proper illumination emphasis.

(c) In *special* instances of heavy pedestrian traffic on primary retail business streets, some sidewalk illumination beneath the underpass may be justified at night. Local conditions will influence the type and location of luminaire equipment, and the specific illumination levels required. Also, should ceiling heights less than 14 feet be encountered, coupled with possible entering and exit grades, both night and day illumination may be required. In general, the illumination level through such underpasses should be at least 50 per cent higher than that along the approaching roadways.

5.3—*Medium Length Underpasses (Approximately 75 to 150 Feet in Length)*—(a) *Daytime* lighting usually is not required for adequate vehicular driver visibility. Daylight penetration from each end plus the silhouette effect of the opposite-end brightness generally assures satisfactory and effective seeing. Possible exception might occur in the case of heavy pedestrian (sidewalk) traffic on primary retail business streets, high length-to-width ratio, and grades or curves which minimize silhouette seeing due to far-end brightness. In such instances, supplementary lighting of 10 to 15 footcandles along the center 50 feet of the sidewalks would seem effective.

(b) At *night* a lighting system through the underpass usually is required. The specific illumination level in footcandles, or degree of visibility, is quite dependent upon the nature and volume of both vehicular and pedestrian traffic and upon the specific location of the underpass. A 5- to 10-footcandle average level may be required for satisfactory visibility and seeing comfort, if the underpass is located on a primary retail business street in a major city. A lower level, 3 to 5 footcandles, should prove adequate for effective visibility incident to secondary traffic streets and highways.

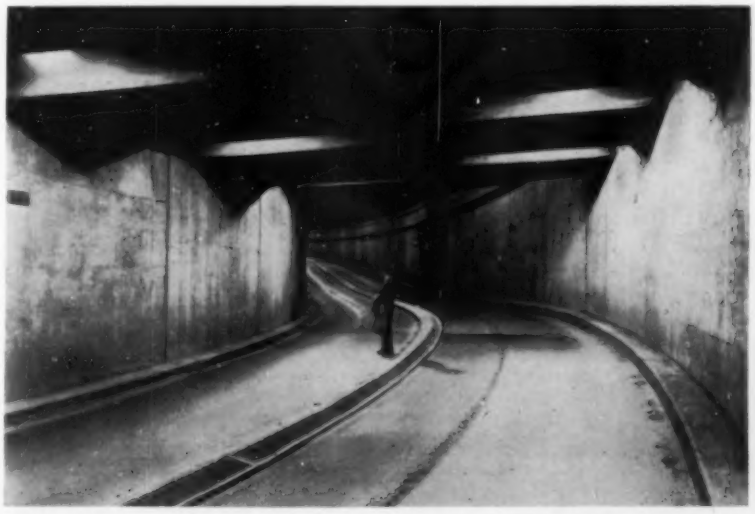

Figure 15. Hunting Park-Ridge Avenue Underpass, Philadelphia, Pennsylvania, is lighted by conventional type street lighting luminaires, using 250-watt mercury lamps, mounted on ceiling recessed between the transverse girders; on approximate 15-foot staggered spacing. The resultant illumination is approximately 6.5 footcandles along the roadway, with uniform, and comfortable, sidewall and pavement brightness.

Figure 16. Underpass in Detroit, Michigan, illuminated by enclosed luminaires, each with two 40-watt fluorescent lamps; recessed between the ceiling girders. The resultant illumination is approximately 3 footcandles average on the pavement, with effective sidewall brightness.

Figure 17. Center-pier underpass with flanking sidewalks at intersection of Randolph Street and the Chicago Northwestern Railroad, Chicago, Illinois. Illumination provided by single-lamp luminaires with 72-inch T-12 fluorescent lamps operated at 600 ma. The luminaires lighting the vehicular pavement are spaced approximately 20 feet apart above the two outer curbs; with a slightly longer spacing of the luminaires lighting the sidewalks. The resultant illumination ranges from 2.5 to 3.0 footcandles over the vehicular pavement. The diagonally-striped face of the center pier is "spotlighted."

Figure 18. Daytime view approaching the entrance of a long underpass (490 feet) in Houston, Texas. Illumination is provided by closely-spaced street lighting luminaires, with 400-watt 20,000-lumen mercury lamps in each upper corner. The resultant illumination is approximately 100 footcandles maximum, graduating downward to about 10 footcandles at the exit end of the underpass. With light-colored sidewalls and ceiling, the resulting inside brightness assures satisfactory entering visibility. (At night, an illumination level of 10 footcandles is maintained.)

TABLE III—Recommended Underpass Lighting.

Length	Daytime	Night
Less than 75 Ft.	None*	None*
75-150 Ft.	Usually None**	7.5 ft-c. Primary business streets. 4 ft-c. Secondary roadways.
Longer than 150 Ft.	See Sections 3.2 and 3.3	7.5 ft-c. Primary business streets. 4 ft-c. Secondary roadways.

*See Section 5.2 for special conditions.
**See Section 5.3 for unusual conditions.

Conventional type street lighting luminaires often prove effective and economical where transverse ceiling girders permit recessing the luminaires between the girders to provide effective shielding. For example see Figs. 15 and 16.

5.4—*Underpasses Longer Than 150 Feet*— In underpasses of this length, both day and night illumination usually is needed.

5.4.1—*Daytime Lighting* — **(a)** The daytime visibility requirements for traffic entering long underpasses are similar to those at the entrance sections of tunnels as described in Section 3. Since, at a 30-mile-per-hour speed motorists pass through a 500-foot underpass in approximately 11 seconds, the illumination treatment outlined in Section 3 should be extended through the *entire length* of the underpass.

(b) When vehicular traffic enters such underpasses at speeds considerably in excess of 30 miles per hour, as on some major expressways, the visibility problem becomes even more acute. Here, illumination and brightness levels inside the portal 25 to 50 per cent higher than Table II recommendations may be required.

5.4.2—*Night-time Lighting* — The required illumination level in long underpasses is influenced by such factors as traffic volume, area location, interior finish and exterior roadway condition. Physical structural details of the underpass will have a major bearing on the specific type and positioning of the luminaires. Lighting levels required are the same as for medium length underpasses as described in Section 5.3. Effective roadway lighting at each end of the underpass will add to the comfort and safety of both vehicular drivers and possible pedestrians. Table III summarizes the above recommended illumination levels.

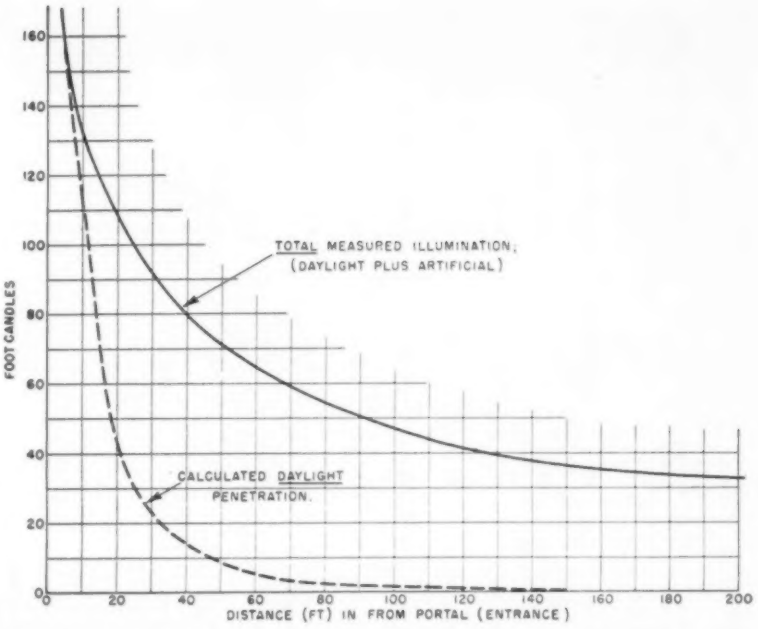

Figure 19. Daytime entrance lighting of the Houston, Texas, underpass. The graph shows both calculated daylight penetration, plus actual footcandle readings during the daytime, along the first 200 feet in from the portal.

Appendix — Data on Some Existing Tunnel Lighting Installations

The information in Tables IV to VI, on the lighting systems in 12 major traffic tunnels in the United States, should be of interest and assistance to engineers dealing with similar problems. These include filament, fluorescent, mercury and sodium light sources in tunnels with 14-foot ceiling heights, as well as of 20- to 25-foot arched type.

In earlier lighting systems, consisting of flush-mounted units intermittently spaced along upper sidewalls (as in the Sumner - Boston and Detroit - Windsor) spotty, specular reflection from ceiling and sidewalls often occurred, with some instances of objectionable luminaire brightness. (See Fig. 2.) The linear-shaped lighting units, used in later tunnel lighting projects, produced a marked improvement in visibility and driver comfort with, generally, reduced source brightness.

These data are included primarily for background and historical value and should not be construed as Committee recommendations.

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[Tables IV to VI on following pages.]

TABLE IV — Physical Data on Lighted Tunnels.

Name & Location	Length (Feet)	Single- or Twin-Tube	Pavement Width (Ft.) & Type	Ceiling Height (Feet)	Type of Ceiling & Walls	Portal Sections	Speed of Entering Traffic	Direction Portals Face	Traffic Density	See Fig. No.
Brooklyn Battery New York, N. Y.	9100	Twin-tube 1-way traffic	21 Brick	Approx. 14	White tile 75% Reflectance	Curved	30-40	N & S	50,000 daily	4
Sumner-Boston	5650	Single 2-way traffic	21.5 Granite block	14 to 15	Concrete ceiling White tile walls	Straight	20	NE & SW	30,000 daily	
Detroit-Windsor Detroit, Mich.	5200	Single 2-way traffic	22 Black top	13 to 14	White tile	1 — Curved 1 — Straight	20	N	20,000 daily	
Liberty Pittsburgh, Pa.	5890	Twin-tube 1-way traffic	21 Concrete	19.5	Black ceiling White walls	Straight	30	NE & SW	Heavy	1, 5, 6
Squirrel Hill Pittsburgh, Pa.	4225	Twin-tube 1-way traffic	24 Light brick	14	White tile	Straight	35	E & W	25,000 daily	
Lake Way Tunnels Seattle, Wash.	1466	Twin-tube 1-way traffic	23.5 Concrete	Approx. 20	Concrete Unpainted	Straight	40	E & W	1500/hr. max.	3
Broadway Oakland, Calif.		Twin-tube 1-way traffic	22 Concrete dark	15	Concrete Unpainted	Curved	40-50	E & W	21,000 daily	
Pennsylvania Turnpike 7 Tunnels	4200 to 6600	Single 2-way traffic	24 Concrete dark	17	Concrete Natural	Generally Straight	40-50	Mostly E & W	Medium	10
Portsmouth-Norfolk Norfolk, Va.	3350	Single 2-way traffic	22	14	White tile	Straight	30	E & W	15,000 daily	
Lincoln New York, N. Y.	7900 approx.	Twin-tube 1-way traffic	21.6	14	Light colored tile	Straight & Curved	30-35	E & W	57,000 daily	11
Broadway San Francisco, Calif.	1616	Twin-tube 1-way traffic	23.5	22	Light tan tile	Approx. Straight		E & W	1500/hr.	
Washburn Pasadena, Texas	3000 approx.	Single 2-way traffic	22	19	White tile	Straight	35	N & S	Heavy	

TABLE V — Lighting Systems — Continuous Burning.

Name & Location	Date Installed	Type & Size of Lamp	Type of Luminaire	Location of Luminaire	Linear Spacing (Feet)	Avg. Ft-c on Roadway	Can Ft-c Be Varied?	Sidewalls & Ceiling Brightness	Comments	See Fig. No.
Brooklyn Battery New York, N. Y.	1950	72" T-8 warm white slimline fluorescent	2 lamps in 3" Pyrex 12' glass sleeve	In each upper corner of each traffic tube	Continuous line	3-6 (2.5-5.5)	Yes, by varying lamp current	Excellent uniformity	Lamp current may be varied from 50 to 120 ma.	4
Sumner-Boston	1934	211-watt PS-30, 3550L, 1500 hr, incandescent filament	Recessed porcelain enameled reflector, diffusing glass cover	In angle junction of wall and ceiling	Approx. 20 opposite	Approx. 3.0 initial	No	Spotty brightness pattern		
Detroit-Windsor Detroit, Mich.	1930	200-watt general service multiple	Flush-type, clear glass cover	Junction of ceiling and side wall	20 opposite	Approx. 3	No	Uniform walls, spotty ceiling		
Liberty Pittsburgh, Pa.	1939	10,000L NA-9 sodium vapor	Enclosed aluminum reflectors	Along center of ceiling	50	2.5 initial	No	Side walls satisfactory, ceiling dark		1, 5, 6
Squirrel Hill Pittsburgh, Pa.	1953	72" T-8 slimline fluorescent	2 lamps in Pyrex glass sleeve	In upper corners of each traffic tube	Continuous line	3-5	Yes	Excellent uniformity	Lamp current varied from 75 to 200 ma.	
Lake Way Tunnels Seattle, Wash.	1951	20000L mercury vapor	Enclosed refractor-reflector, shielded	Suspended from arched ceiling	Approx. 40	4-5 initial	No	Fairly uniform		3

TABLE V — (Continued).

Broadway Oakland, Calif.	1937	150-200-300 watt incandescent filament	Enclosed refractor type	In ceiling over center of pavement	15	.5-.6	No	Fairly uniform		
Pennsylvania Turnpike Tunnels	1940	250-watt H-5 mercury vapor	Open reflector type	Recessed in ceiling	37	Approx. 3	No	Dark ceiling, spotty side walls		10
Portsmouth-Norfolk Norfolk, Va.	1952	96" T-8 slimline fluorescent	2 lamps in Pyrex glass sleeve	In upper corners of traffic tube	Continuous line	6-8	Yes	Very uniform	Normal current approx. 140 ma.	
Lincoln New York, N. Y.	1937	150-watt incandescent filament	Flush-type porcelain, clear glass door	Junction of side wall and ceiling	20 opposite	2.0	No	Fairly uniform		11
Broadway San Francisco, Calif.	1953	72" T-8 slimline fluorescent	Enclosed plastic cover	Along center of ceiling	Continuous line	13-14	No	Very uniform		
Washburn Pasadena, Texas	1951	72" T-8 slimline fluorescent	Enclosed single	Along center of ceiling	Continuous line	4-5	Yes	Very uniform	Lamp current 120 ma.	

TABLE VI — Supplementary Daytime Entrance Lighting.

Name & Location	Type & Size of Lamp	Type & Location of Luminaire	Linear Spacing (Feet)	Avg. Ft-c on Pavement	Is Footcandle Level Graduated?	Degree of Sidewall Brightness	Length of Entrance Section Treated (Feet)	Comments	See Fig. No.
Brooklyn Battery New York, N. Y.	72" T-8 slimline fluorescent	Same as "continuous burning circuit"	Continuous line	15 down to approx. 3	Yes. Decreases along 1800' in from portal	Excellent, uniform	1800		4
Sumner-Boston	211-watt 1500-hour multiple incandescent filament	Same as "continuous burning circuit"	7 to 20 opposite	12 down to 3	Yes	Fairly uniform wall brightness	300-350	Shielding buildings assure better visibility at Boston portal	
Detroit-Windsor Detroit, Mich.	200-watt general service multiple	Same as "continuous burning circuit"	10 & 15 linear & opposite	7 to 3	Yes	Side wall brightness rather inadequate	Approx. 500	Visibility improved by curve at Detroit end	
Liberty Pittsburgh, Pa.	1000-500 watt, multiple incandescent filament	Enclosed floodlights suspended from ceiling in 3 banks	50 between banks	100 down to 20	Yes	Quite satisfactory	Approx. 200		1, 5, 6
Squirrel Hill Pittsburgh, Pa.	72" T-8 slimline fluorescent	Same as "continuous burning circuit"	Continuous line	Approx. 20 to 5	Yes	Very effective	Approx. 1800		
Lake Way Tunnels Seattle, Wash.	20,000L mercury vapor	Enclosed refractor type suspended from ceiling	Approx. 7 increasing to 30	Approx. 50 to 5	Yes	Fairly satisfactory	Approx. 250	Controlled by photo-cell switches	3
Broadway Oakland, Calif.	20,000L mercury vapor	Enclosed refractor, staggered; from ceiling and side walls	30 to 60	10 to 1.5	Yes	Spotty and unsatisfactory	300	Also 150' louvered ceiling structure outside portals	
Pennsylvania Turnpike Tunnels	250-watt H-5 mercury vapor	Open reflector type recessed in ceiling	10 to 37	Approx. 12 to 3	Yes	Quite spotty and unsatisfactory	Approx. 250		10
Portsmouth-Norfolk Norfolk, Va.	96" T-8 slimline fluorescent	Enclosed Pyrex glass sleeve in upper corners, 2 rows	Continuous line	Approx. 25	No	Satisfactory, uniform	Approx. 350	Lamp current 350 ma.	
Lincoln New York, N. Y.	150-watt incandescent filament	Flush-type recessed, enclosed	10 opposite & 16 opposite	5 to 2	Yes	Uniform, but too low avg. brightness	Approx. 200	36' portal height permits effective daylight penetration	11
Broadway San Francisco, Calif.	72" T-8 & T-12 slimline fluorescent	Enclosed, center of ceiling	Continuous line	21 to 26	No	Excellent uniformity	Approx. 400	Satisfactory eye adaptation	
Washburn Pasadena, Texas	72" T-8 slimline fluorescent	Enclosed, on upper ceiling	Two continuous lines	18 to 4	Yes	Adequate uniformity	300	Lamp current 200 ma.	

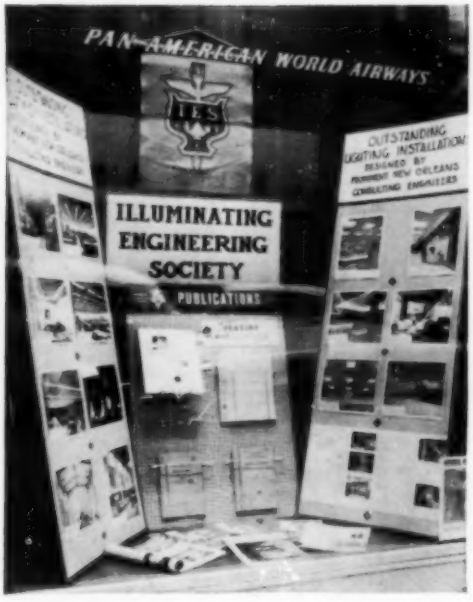
Here and There With I.E.S. Members

QUEBEC Chapter, I.E.S. first bilingual group attracted 72 non-member guests at its extension meeting in St. Foy, Quebec, April 30. Presiding officer at the meeting was Mayor of St. Foy, Emile Boiteau.

GOLDEN Gate Section was host to national officers at its March meeting. Guy de Leuze, left, greets President Marshall Waterman, and General Secretary R. G. Slauer (right).

WINNERS of the Architectural Competition sponsored by Ohio Valley Section of I.E.S. for architecture students of the University of Cincinnati. Front row l. to r., Charles Stark, 1st award; Ben Thaddeus, 2nd award; Herbert Lawton, 1st award. Back row l. to r., Douglas Meyer, honorable mention; Robert Cooper, 2nd award; Lonnie Overton, mention; Robert Beckley, mention.

AMERICAN visitors to British I.E.S. On the occasion of their recent trip abroad, two well-known I.E.S. members attended the annual dinner dance of the British Society. Left to right are Dr. John Strange, Thorn Electric Industries, London, George Clark and A. C. Kendall, Sylvania Electric Products Inc., Wheeling, West Virginia; Dr. H. C. Weston, Institute of Ophthalmology, University of London, London.



WINDOW display sponsored by New Orleans Section during National Engineers Week. Placed in the Pan American World Airways window, New Orleans, it featured outstanding lighting installations designed by prominent New Orleans consulting engineers and, in the center, I.E.S. publications.

LIGHTING NEWS

Eleventh Annual

Pacific Northwest Regional Conference
Victoria, B. C., March 28-30, 1957

Vancouver Island Chapter of I.E.S., at Victoria, B. C., has exactly 26 members. This will promptly triple, undoubtedly. Over 200 people had an opportunity, during their Regional Conference, to observe the professional, capable, serious feeling for lighting, and for I.E.S., which is characteristic of members in this area. Probably nowhere else could a meeting of such stature be conducted by so few. Every phase of their conference was I.E.S. at its best — dispensing information on the latest developments; education panels; open forums; trends; technical papers; application demonstrations; 100 per cent Chapter attendance. And fun.

Even the meeting room had a few innovations worth copying. Attention was attracted to the stage by two life size streetlighting standards in the well-known design indigenous to Victoria, complete with the famous hanging baskets of flowers (real). The audience (s.r.o.) were supplied, not with the usual folding straight-backed chairs, but with huge upholstered club chairs, chesterfields, and other comforts of a long day's session. The international nature of this I.E.S. Region (the only one which crosses both borders) was emphasized by crossed flags on the curtain, the Stars and Stripes, and the Union Jack.

Although the coffee break has penetrated to that side of the border also, it applies only to the morning. For the afternoon recess, the entire delegation joined the ladies in the Empress lobby for tea and crumpets. This is a ritual performed nowhere on this continent quite as it is in English Victoria. For charm and graciousness, it cannot be surpassed, and to provide an atmosphere in full-circle contrast to the serious absorption of sessions, is greatly to be recommended. Mere recess though it might be considered, it was much more than a change of pace; transition to a different way of life would be more descriptive. A mellowing experience, taken home as part of the pleasure of visiting Victoria.

Technical Sessions

Like the famous report of the six blind men on the nature of an elephant, many different reports could be made on an I.E.S. Regional Conference. Depending on his reasons for going, any given delegate could give a totally different emphasis. At the Victoria conference, however, the technical program packed its own jolt. From the first bang of the gavel (by Gordon Roper, Conference Chairman) through a Saturday morning session three days later featuring a display of historical streetlighting units, momentum never slackened.

The opening session March 28 started with an exceptionally warm address of welcome by His Worship, the Mayor of Victoria, Mr. Percy Scurrah. Special feature of this session, however, was a report on the Region, by Ken Reid, Regional Vice-President, and a discussion of the "Three Dimensions of Lighting" (quantity, quality and pleasantness) by Marshall Waterman, I.E.S. President.

The remainder of the morning's session was scheduled to be an hour's talk on "Trends in School Lighting" by Willard Allphin, Sylvania. Such was the interest in this paper, however, that it developed into an additional hour's open forum with dozens participating. Only pangs of hunger terminated the discussions, several of them "papers" in themselves, as the meeting extended well into the luncheon period. The interesting aspect of this lively discussion is that it was not planned but was sparked spontaneously from the interest in the subject, and Mr. Allphin's stimulating paper.

Another highlight of the technical program could well be the panel discussion on sawmill lighting, conducted by D. S. Gordon as moderator. This too met with enthusiastic audience participation; sawmill lighting is a prominent lighting

SETTING the stage for a successful Pacific Northwest Conference: typical Victorian streetlighting units, the flags of two nations, and the President of I.E.S., Marshall N. Waterman.

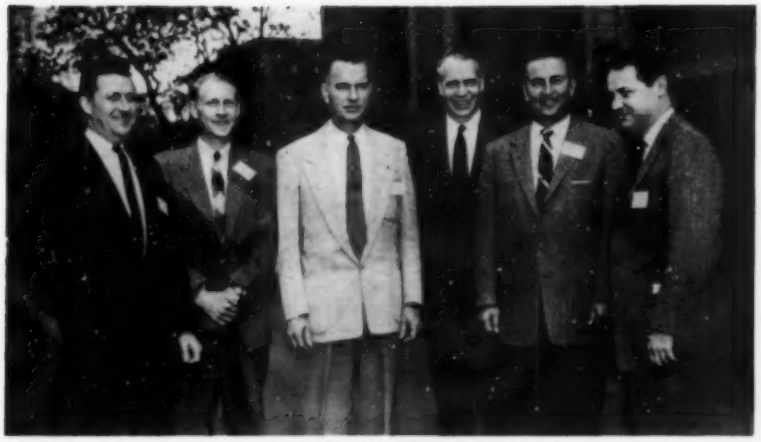
ELEMENTS OF A SUCCESSFUL CONFERENCE

THESE MEN planned it — (seated l. to r.) George Langdon, Registration Chairman; John Morrison, MMILJ Contest Chairman; George Geddie, Entertainment; Walter Beek, Chapter Secretary; Gordon Roper, Conference Chairman; Tom Emes, Transportation; Alf Evans, Hotel. Standing, l. to r., Righton Parker, Finance; George Douglas, Attendance and Public Relations, and Stickney Harris, Vancouver Island Chapter Chairman.

THESE MEN ran it — At left: Kenneth Reid, Regional V-P; Stickney Harris, Chapter Chairman; Gordon Roper, Conference Chairman. At right: Section Chairman: l. to r., D. E. Seely, Oregon; Ken Reid; Dr. H. C. Hall, Puget Sound; Reg Jarvis, Edmonton; Marshall Waterman, I.E.S. President; George Romans, Inland Empire Chapter; Doug Gordon, B. C. Section; Stickney Harris, Vancouver Island.

THESE ATTENDED. Group picture on steps of Empress Hotel, Victoria, B. C.

SPEAKERS



MMILJ contestants. L. to r., Jack T. Cottingham, Oregon Section; John H. Morrison, Chairman of the contest; Don Statham, Oregon Section; Paul Donnelly, British Columbia Section; Bert Heinz, Puget Sound Section, and Walter Haspedis, Inland Empire Chapter.

Prof. Dan Finch, center, Univ. of California, discusses program with Stickney Harris, left, and Gordon Roper, right, Conference Chairman.

Kenneth Reid, right, displays part of his priceless collection of historical lamps. Gordon Roper, left, and President Waterman look on.

problem in the northwest. Experts bombarded with questions were T. W. Beadle, Washington Water and Power Co., Spokane; Professor Dan Finch, University of California, Berkeley; W. S. Gordon, Consulting Engineer, Tacoma; Stickney Harris, B. C. Electric Co., Victoria.

Actually, all of the program was high level. Some seven Vancouver and Victoria architects bought tickets for specific sessions. These, and all of the delegates, surely left the conference with a confident, serious feeling about the rightness of good lighting.

MMILJ

Six first place winners for Sections/Chapters competed in the Regional contest for My Most Interesting Lighting Job, two for Class I Residential; four in Class II, Commercial. Judges were Marshall Waterman, President of I.E.S.; Arthur Tyler, Corning Glass Works, San Francisco, and Ruby Redford, Editor of I.E. Winners and contestants were:

Class I Residential

FIRST PRIZE: Jack Cottingham, Lighting Consultant, Portland General Electric Co. His job: "Electri-Living Home," featuring a sunshine room.

SECOND PRIZE: Basil McLaren, McLaren Electric Ltd., Vancouver, British Columbia Section. Mr. McLaren's interesting job covering the lighting of his own home.

Class II Commercial

FIRST: B. T. Heinz, B. T. Heinz Co., Seattle, Wash., Puget Sound Section. "Design for Lighting Sales Laboratory."

SECOND: Walter L. Haspedis, Columbia Electric & Mfg. Co., Spokane. Inland Empire Chapter. "Newspaper Pressroom."

THIRD: Don Statham, Pacific Power & Light Co., Coos Bay, Oregon. Oregon Section. His job: "Light for Seeing, Selling and Servicing."

Paul Donnelly, Northern Electric Co. Ltd., Vancouver. British Columbia Section. "Lighting My Church" — featuring both interior and exterior lighting.

LOCAL ACTIVITIES

As far as the operation of Sections and Chapters is concerned, an important highlight of any regional conference is the Local Activities meeting. At Victoria, 37 incoming and outgoing Section/Chapter officers, together with headquarters staff present, met at 7:30 in the morning for an extremely valuable discussion of some thirteen items on the agenda. Ken Reid, Regional Vice-President was chairman. Complete Minutes were recorded by Miss Shirley Martin who served as secretary. Out of this

HIGH JINKS

HEAD table at the President's banquet.

MERRYMAKERS, Lance Robson and Mrs. Robson; Tom Emes and Mrs. Emes; the Percy Fletchers.

JACK WELLS (picture at left) has a lot of friends to see, Empress Hotel miles of corridor. For his social calls he simply rented a bicycle. Greeting him are Doris Roper and Joyce Harris. At right, "Town Crier" George Geddie, Entertainment Chairman, startles the town. Behind him, Stickney Harris, Gordon Roper and Ken Reid, Regional V-P.

meeting developed a special program to stimulate the interest of students in illumination. The whole Region will participate in supplying I.E.S. literature to students; meanwhile, Oregon Section will make a project of this. A regional task committee to develop a booklet specially for the students was also considered.

Public Relations

Public interest in what went on at the conference was considerable. The press, radio and television interests covered it widely, one newspaper (*Journal of Commerce Weekly*) devoting its entire issue to lighting news, and especially features of the I.E.S. Regional Conference. Portable television cameras were sent to pick up several of the sessions, including the MMILJ contest and also the tea, for rebroadcast on Vancouver Channel 2. Interviews with Mr. Waterman, and other I.E.S. notables were also featured on radio and television.

Socially

The Entertainment Committee were way ahead, just by virtue of the location — Victoria, B. C. in the Springtime. In addition, however, they planned several happy affairs, and the B. C. and northwest members took it from there. Top feature was, of course, a banquet at the Empress Hotel, in itself a citadel of English charm. This was in honor of President and Mrs. Waterman. Gifts were bestowed on them, representative of the northwest area, and with the good wishes of the Region: Mrs. Waterman, a sealskin purse and knee-length deerskin mocassins. For Mr. Waterman, a heavy hand-knit Indian sweater found only in this territory.

Two Scotch lassies in kilts piped the head table in to the banquet. During dinner, entertainment was furnished by another braw Scot, also in kilts, John Dunbar, baritone.

An unscheduled feature of the entertainment occurred during the banquet. Reg Jarvis, Chairman of the Edmonton Chapter presented Don Frost, Chairman of the Chinook Chapter with a beautifully illuminated framed list of the Chinook Charter Members. Mr. Frost then did likewise, with a list of Edmonton's Charter Members, while the crowd sang "We Be-long to a Mu-tual Ad-miration Society."

Seventy ladies attended the conference, and participated in even further fun. In addition to joining the men for tea and crumpets, and for a cocktail party Wednesday evening, they had several excursions of their own. These included a scenic and historic conducted tour of Hatley Castle, and luncheon at the Oak Bay Beach Hotel noted for its charming English atmosphere.

FOR THE RECORD

Complete details of the technical program were as follows:

Thursday, March 28

Opening Session

Gordon Roper, Conference Chairman.
Mayor Percy Scurrah, City of Victoria.
Ken Reid, Regional Vice-President, Pacific Northwest Region.
M. N. Waterman, President, Illuminating Engineering Society.
Coffee.

Morning Session

R. C. B. Jarvis — *Chairman.*
"Trends in School Lighting," Willard Allphin, Sylvania Electric Products Inc., Salem, Mass.
Luncheon.

Afternoon Session

Dr. Howard C. Hall — Chairman.
"My Most Interesting Lighting Job" Contest.
Tea and Crumpets.

Friday, March 29

Local Activities Breakfast Meeting
Duke of Kent Room
K. Reid, R.V.P. — *Chairman*

Morning Session

George E. Romans — *Chairman.*
"Lighting the New B. C. Electric Office Building, Vancouver" — M. A. Thomas, Consulting Engineer and T. H. Doherty, B. C. Electric Co.
Coffee.
"Current Practice in Sawmill Lighting" — Professor Dan Finch, University of California.
Panel Discussion on Sawmill Lighting, Moderator — D. S. Gordon, B. C. Electric Co.

Afternoon Session

Don Frost — *Chairman.*
"Luminous Environment in the Home," Charles N. Clark, General Electric Co., Nela Park.
Host Cocktails — Georgian Lounge.
President's Banquet, Crystal Ballroom.

Saturday, March 30

Morning Session

D. E. Seeley — *Chairman.*
"History of Street Lighting in Victoria" — Ken Reid, Electrical Engineer, City of Victoria.
"Recent Developments in Light Sources and Optical Systems for Roadway Lighting" — E. B. Karns, Westinghouse Electric Corp., Cleveland.
Coffee.
"Color in Light and Lighting" — Charles N. Clark, General Electric Co., Nela Park.
Closing Remarks—M. N. Waterman, President; Kenneth Reid, Regional Vice-President.

CREDIT DUE

Virtually every member of the Vancouver Island Chapter worked on this conference. Specific responsibility, however, was taken by the following:

Ken Reid — Regional Vice-President

British Columbia Section

Chairman	D. S. Gordon
Secretary	A. Anderson

Chinook Chapter

Chairman	D. Frost
Secretary	D. Little

Edmonton Chapter

Chairman	R. C. B. Jarvis
Secretary	Fred R. Forward

Time: March 28-30, 1957
Place: Empress Hotel, Victoria, B. C.
Attendance: 216
139 delegates
70 ladies
7 separate sessions

Inland Empire Chapter

Chairman	George E. Romans
Secretary	Ted Beadle

Oregon Section

Chairman	D. E. Seely
Secretary	John A. Schulter

Puget Sound Section

Chairman	Dr. Howard C. Hall
Secretary	Jack H. Wells

Vancouver Island Chapter

Chairman	A. S. Harris
Secretary	Walter E. Beek

Conference Committees

Conference Chairman	G. J. Roper
Papers and Program	W. G. McIntosh
Finance	R. Parker
Attendance and Publicity	G. E. Douglas
Registration and Reception	G. Langdon
Lighting Contest	J. Morrison
Properties and Electrical	J. Pye
Hotel	A. Evans
Transportation	T. Emes
Entertainment	G. Geddie
Ladies	Mrs. K. Reid

Ladies' Committee

Mrs. K. Reid
Mrs. S. Harris
Mrs. G. Roper

South Pacific Regional Conference
April 3-5, Los Angeles

In its personnel, the South Pacific Region is, apparently, blessed with large numbers of old pros. Right from registration, which is invariably smooth and efficient, through canny programming, well-organized entertainment and other faultlessly-run features, the whole conference spells *experience*. About 300 people attended with, as usual for this Region, numerous "outsiders" as well for particular phases of the program.

An innovation was an afternoon start. Call to order and introductions (by Bill Shalda, Conference Chairman) was at two o'clock Wednesday afternoon, April 3. Keynoter was Otto K. Olesen. Though billed as Postmaster of the City of Los Angeles, his present post, Mr. Olesen is also a long-time lighting professional and motion-picture lighting specialist from way back. Currently, in addition to his office as Postmaster, he heads a Lighting Committee for glamorizing Hollywood Boulevard. To make this famous street as spectacular as tourists expect it to be, lighting to about 15 footcandles is being planned, with pink sidewalks and numerous other unusual attractions for visitors.

Marshall Waterman, I.E.S. President, was introduced at this opening session, and was himself introduced to the vagaries of the California climate. It seems Mr. Waterman had inquired of the committee before his trip west what clothes he should bring. Since nobody knows from one day to the next what to expect from the weather in April, the Committee presented him with (a) long johns with his initials daintily embroidered in sequins, (b) plaid shorts and (c) smog mask.

MMILJ

The conference then settled down to business with the contest first on the agenda. Every Section and Chapter within the Region was represented, and with the knowledge that this Region won the National prize last year, competition was serious, and keen. The program was under the direction of Bob Ford, MMILJ Chairman. Judges were: Carlton Thompson, Audie Asheroft, Roy Dahlin, Earl L. Holmberg and John Epperson. Contestants and results:

Class I — Residential

First — Albert Schramm, San Diego Chapter. House of Rodriques in Tia Juana, Mexico.

Class II — Commercial

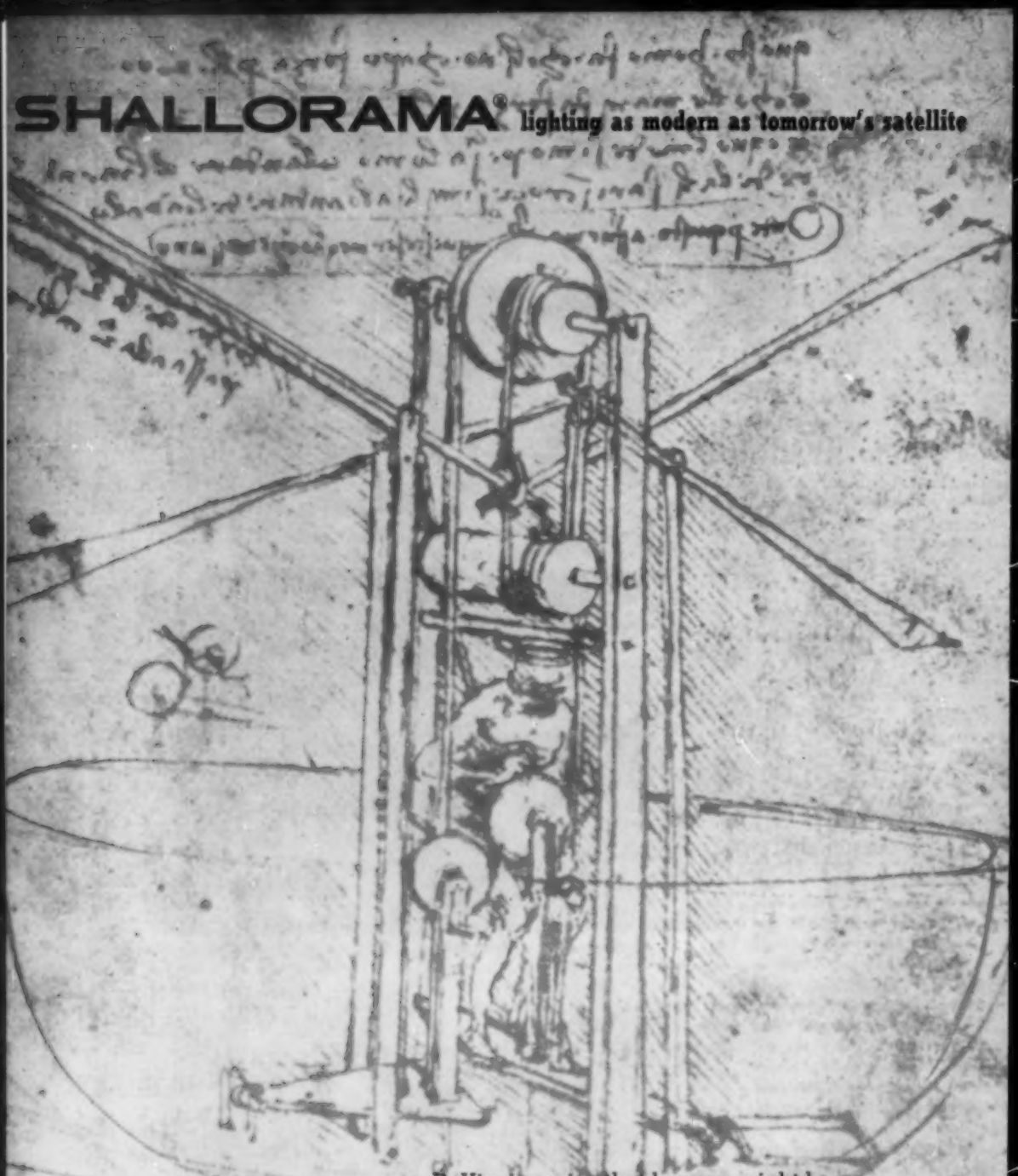
First: Harold Strahn, Southern California Section. Seventh Day Adventist Church.
Second: Warren Smith, Golden Gate Section. Jewelry Store.
Third: George Smedberg, San Jose Section. High School Auditorium.
Mel Fenton, Mother Lode Chapter. Low level parking deck.
Arthur Collins, San Diego Chapter. Nursery-aquarium.

SCHOOL LIGHTING REPORT

Over 100 people met for breakfast at 7:30 in the morning April 4, to hear the report of the Joint Task Committee of I.E.S., A.I.A. and the National Council for Schoolhouse Construction. Representatives from these three groups had worked together for the past four years to study all phases of school lighting. In this time they had, of course, developed a high degree of mutual trust in each

(*Continued on page 15A*)

SHALLORAMA® lighting as modern as tomorrow's satellite

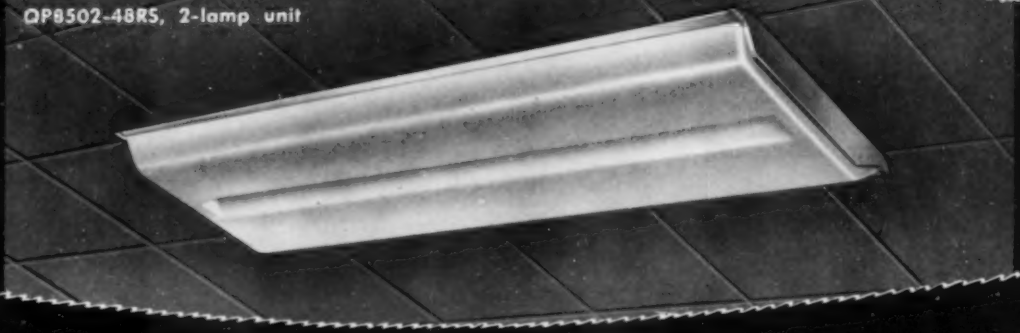


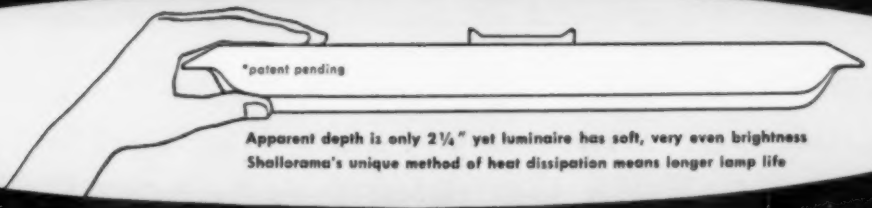
DaVinci, genius that he was, might have anticipated the earth satellite project. Yet, did he ever dream of lighting as modern as the SHALLORAMA! Extremely shallow in appearance (2¼"), this new, meticulously engineered, surface-mounted Sunbeam Lighting Company Visionaire looks more like a custom-styled, recessed luminous cell forming an integral part of the architecture. The simplicity with which the SHALLORAMA may be installed and maintained combined with the many quality features for long, efficient life means real, money-saving satisfaction to building owners. Normal two-screw mounting over existing outlets makes this unit the perfect answer to any modernization or relighting project. Now available in two-lamp width as well as four, the SHALLORAMA offers the finest lighting and the widest range of application. Write for bulletin A66 to help you plan lighting which will remain as modern as the future.

QP8504-48RS, 4-lamp unit

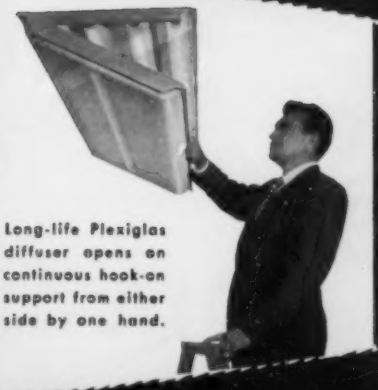
No latches, no hinges, no visible hardware mars the beauty of the SHALLORAMA®

QP8502-48RS, 2-lamp unit





Apparent depth is only 2¼" yet luminaire has soft, very even brightness
Shallorama's unique method of heat dissipation means longer lamp life



Long-life Plexiglas diffuser opens on continuous hook-on support from either side by one hand.

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SUNBEAM LIGHTING COMPANY

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Operating advantages embodied in the Sola Constant Wattage Mercury Vapor Lamp Transformer have proved so desirable and practical that this type of ballast is fast becoming the generally-accepted standard for mercury vapor lighting installations. Now constant wattage operation plus the economy of two-lamp ballasting is available in a single Sola CW Mercury Vapor Lamp Transformer.

This new design is specifically for two-lamp, outdoor service in commercial and industrial applications of H-1 400-watt mercury vapor lamps. Its famous Constant Wattage Principle of operation offers users the following performance features:

- *Low starting current surge*
- *Regulated lamp wattage and light output*
- *Open circuit protection*
- *Elimination of need for primary taps*
- *No extinguishing on line voltage dips*
- *Extended lamp life*

For additional information on your particular application, contact your sales engineer listed below. He's one of a nationwide organization maintained by Sola Electric Co. to provide you with prompt service.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**

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At the

South Pacific Coast Regional Conference
April 3-5, 1957, Hotel Statler, Los Angeles, California.

All pictures on this and the next page are with the compliments of Judd Hawthorne, Hawthorne Studios, Los Angeles, and William Cyr, *Electrical West*, San Francisco.

VIP's: President of I.E.S., Marshall Waterman, Jake Hochenauer, host Section Chairman, Bill Shalda, Conference Chairman. Directly below, President Waterman displays gift of long johns for the California climate.

GIFT of transistor clock presented to President Waterman by C. M. Thompson, Regional V-P, during featured luncheon. Dex Hinckley, far right, looks on. Photographer shown is Judd Hawthorne; Bill Cyr took the picture.

SEEN at the President's cocktail party, left, President's luncheon lower left. Directly below, raffle ticket bought coffee during session recess; Bill Shalda, Conference Chairman poured.

The Program

CREDIT for excellent program belongs to Roy Jones, left above, seen discussing details with Chairman Shalda.

MMILJ contestants. Front row: Harold Strahn, Mel Fenton, Albert Schramm, George Smedberg. Back row: Arthur Collins, Warren Smith.

KEYNOTER Otto Olesen at left. Picture at right above, Guy de Leuze center, Golden Gate Chairman, with speakers Carl Allen, left, and Cash Crouch, right.

Harold Strahn, Southern California Section receives check and certificate as winner of MMILJ contest.

Speakers W. H. Ritter, R. C. Allison, Byron Payne.

SCHOOL lighting Task Committee report was made to 100 people attending breakfast meeting. John Chorlton, Chairman of School Lighting Committee is standing.

Luncheon speaker Frank Gonzalez, Kierulff Corp.

(*Continued on page* 18A)

Announcing . . .

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PERFECLITE

Perfeclite now offers a new **hammer lock** design in incandescent ceiling pan lighting fixtures. No other ceiling pan fixture on the market today has all these engineering features:

- Globe opens on **hinge** for quick easy cleaning and relamping.
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- Provides **ceiling illumination** as well as **evenly distributed floor lighting.**
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Perfeclite's new hammer lock fixture is available in the following sizes:

Model	Glass Diameter	Wattage
HH-9	8″	2- 40 W
HH-11	10″	2- 60 W
HH-13	12″	2- 75 W
HH-15	14″	2-100 W
HH-17	16″	3-100 W

Send for new Perfeclite Catalog 956 giving full information on our entire line of Commercial Incandescent Fixtures and Exit Units.

Fixtures are Underwriters Laboratories, Inc. approved.
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PERFECLITE PRODUCTS
THE MARK OF LIGHTING SERVICE

of the others' viewpoints. They feel ready now, as reported at this meeting, to make definite recommendations to the School Lighting Committee which are in agreement with all of these interested groups, for the forthcoming revision of the American Standard Practice for School Lighting. Led by John Chorlton, Chairman of the School Lighting Committee of I.E.S., a panel discussion ensued with detailed reports by representatives of each of the groups. Charles Gibson, Chairman of the delegation for the National Council for Schoolhouse Construction explained that his organization represented the "kids and teachers." Their objective is to up-grade the visual environment in schools, and they are convinced that no single group can develop the right answer to this; mutual discussion by all concerned is no longer a venture but a necessity in the development of a really valuable school lighting practice, he said.

C. L. Crouch, I.E.S. Technical Director described to the group how proof data from research were applied throughout by the Task Committee in their study leading to final agreement. Foster K. Sampson, a consulting engineer representing A.I.A., outlined the new school teaching concepts which affect the visual environment, and discussed several aspects of lighting design, both natural and electrical, which will be considered in future revisions.

The early hour notwithstanding, delegates attending this panel had the unique advantage of hearing, first hand and for the first time anywhere, the final report of this important Task Committee study.

Local Activities Breakfast

Friday, April 5, also started at 7:30 in the morning with a Regional Activities breakfast meeting directed by C. M. Thompson, Regional Vice-President. Some 45 officers of the Region's five sections and chapters attended this. The problems brought up included close cooperation between Sections for speakers and co-ordinated dates; national committee appointments (volunteer lists will be sent from this Region to headquarters); Regional Executive Committee meetings early in the year; expansion of the lighting contest, and other phases of local operation.

Technical Program

It is evident, even from a listing of titles given at the end of this report, that the papers presented at this conference were of a high order. Special mention, however, could be given to the series of talks Thursday morning on "Outstanding California Lighting Jobs." The nature of this program was a departure from usual I.E.S. procedure, in that all of the speakers were *users* of the installations described, rather than the designing engineer. They were not members of I.E.S., nor were they lighting specialists. Their enthusiasm and appreciation of the finer points of the good lighting installations with which they "lived" was especially stimulating, and was, of course, an excellent testimonial to the benefits of lighting principles. A similar series on other conference programs could be recommended by all who heard this presentation.

Social Program

Though not designed as part of the entertainment, the coffee break each morning turned out to be part of the fun. To meet the Statler's high cost of coffee, a raffle was run each day for very desirable prizes donated by Sustaining Members. Coffee for some was a dollar a cup, but they had the suspense that goes with hope. And the winners, of course, hit the jackpot.

Planned entertainment was abetted by the interesting things to do and see in Los Angeles. The President's Banquet on Thursday evening, for instance, was in the Terrace Room of the Statler Hotel, and included this famous restaurant's floor show and dancing. Featured entertainment was Nelson Eddy, "Shortnin' Bread" too. The banquet was preceded by a Cocktail Party in honor of President and Mrs. Waterman.

President Waterman was also guest of honor at a "President's Luncheon" Friday noon. On this occasion gifts were presented, a charm bracelet for Mrs. Waterman bearing charms which would commemorate her trip; for President Waterman a beautiful Transistor clock.

Mrs. Roy H. Kreyser, an experienced hand at entertainment, proved it for the ladies' program. Every phase showed good organization and well-planned details. Special events for the 100 or so ladies attending started with a get-acquainted lunch at Robinson's Department store. Next day they again lunched together at the Walt Disney Studio and later toured this interesting place. Friday was a full day for the ladies. Starting right after breakfast they attended the CBS radio Art Linkletter's House Party and the Bob Crosby Show. From the studio they went to the famous Farmer's Market for lunch, and got back to the Statler in time to hear the closing papers which were to their special interest: "Garden Decoration with Light" by W. H. Ritter, and "Home Decoration with Light" by Byron Payne.

Complete Program

For the record, the complete program for the conference was as follows:

Wednesday Afternoon, April 3
Chairman, Jake Hochenauer
Chairman, Southern California Section

Call to Order and Introductions — Bill Shalda, Conference General Chairman.
Address of Welcome — Otto K. Olesen, Postmaster, City of Los Angeles.
My Most Interesting Lighting Job Contest.
Festival Lighting—Bill Todt, Hollywood Sound and Lighting.

Thursday Morning, April 4
7:30 A.M. Breakfast
Jake Hochenauer, Chairman

Report on work of Joint Task Committee of I.E.S., A.I.A., and National Council for Schoolhouse Construction.
Panel: C. L. Crouch, Technical Director I.E.S.
John Chorlton, Chairman, School Lighting Committee, I.E.S.
Foster K. Sampson, A.I.A. Representative.
Chas. Gibson, National Council for Schoolhouse Construction.

Sessions
Chairman, Guy De Leuze
Chairman, Northern California Section

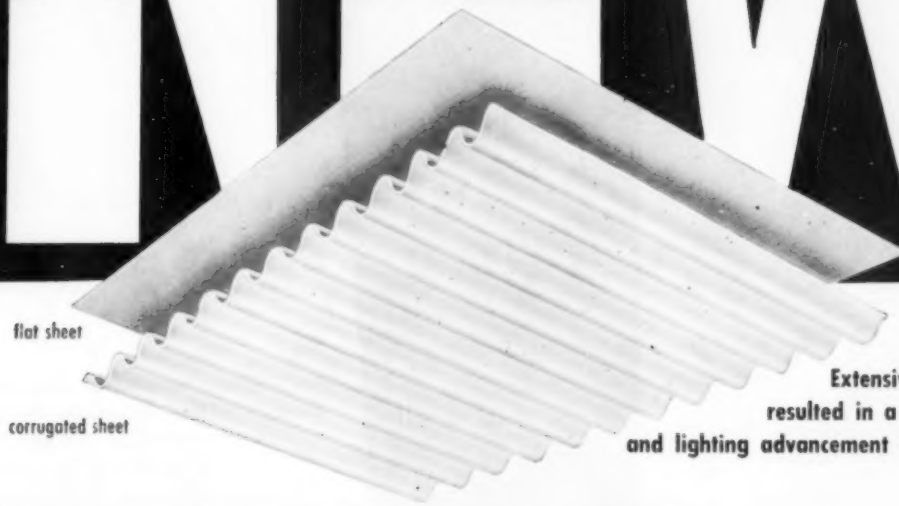
Effect of Illumination on Production, C. L. Crouch, Technical Director, Illuminating Engineering Society.
Coffee Break.
Visual Comfort and Illumination, Carl J. Allen, General Electric Company, Nela Park, Cleveland, Ohio.
Outstanding California Lighting Jobs:
Metwood Installation, Jerry Shane, President, Metwood Mfg. Corp.
Lighting at Helipot Corp., W. M. Semple, Mfg. Director, Helipot Corp., Costa Mesa, Calif.
Illumination of Felicita Elementary Classroom No. 18, Raymond A. Jung, Architect.
Office Lighting at Beckman Instrument Co., Berkeley, Calif., Robert L. Sawyier, Pacific Gas & Electric Co., Oakland, Calif.
Lunch.
Hi Fi and Stereophonic Sound Today, Frank Gonzalez, Kierulff Sound Corp., Los Angeles.

(*Continued on page* 21A)

I.E.S. National Technical Conferences

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia
1958 — August 17-22 — Royal York Hotel, Toronto, Ontario
1959 — September 7-11 — Hotels Fairmont and Mark Hopkins, San Francisco, California
1960 — September 11-16 — Penn Sheraton Hotel, Pittsburgh, Pennsylvania
1961 — September 24-29 — Chase Park Plaza Hotel, St. Louis, Missouri

NEW



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Poughkeepsie:
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(*Continued from page* 19A)

THURSDAY AFTERNOON
Chairman, M. P. Fenton
Chairman, Mother Lode Chapter

How to Get Your Money's Worth in Lighting Equipment, Hugh McCulloch, Independent Testing Laboratories, Boulder, Colo.
Maintenance of Lighting Installations, Willard Allphin, Sylvania Electric Products, Salem, Mass.
Coffee Break.
Unusual Lighting Techniques, Tom Warren, Ultra-Violet Products, San Gabriel, Calif.

THURSDAY EVENING
Cocktail Party.
President's Banquet.

FRIDAY MORNING, APRIL 5

7:30 A.M. Regional Activities Breakfast
C. M. Thompson, Chairman,
Regional Vice-President

SESSIONS

Chairman, Gordon S. Kimball
Chairman, San Diego Chapter
New Aspects of Street and Highway Lighting, E. B. Karns, Westinghouse Electric Corp., Cleveland, Ohio.
Coffee Break.
Building Floodlighting, M. R. Gregory, Shalda Manufacturing Co., Burbank, Calif.
Parking Area Lighting, Al. Pryor, Southern California Edison Co., Los Angeles, Calif.
Best Applications for New Light Sources, Frank Lee, General Electric Co., Los Angeles, Calif.
President's Luncheon.
President's Address, Marshall N. Waterman, President, Illuminating Engineering Society.

FRIDAY AFTERNOON
Chairman, George Baker
Chairman, San Jose Chapter

Guides in the Use of Color, R. C. Allison, T. Eatons of Canada, Toronto, Ont., Canada.
Coffee Break.
Garden Decoration with Light, W. H. Ritter, California Electric Power Co., Riverside, Calif.
Home Decoration with Light, Byron Payne, Arizona Public Service Co., Phoenix, Ariz.
Adjourn.

CREDITS

Success for this Conference is due, undoubtedly, to the high degree of cooperation of the various Sections and Chapters within the Region. Each of the sessions was conducted by the Section Chairman. Plans and execution of all events were by:

General Chairman	William Shalda
Vice-Chairman	Audie Ashcraft
Attendance	J. M. Russell
Budget	Don Prideaux
Entertainment	Lloyd C. Reuscher
Finance	Roy Bevan
Hotel	Hugh X. Sheeter
Ladies	Mrs. Roy H. Kreyser
Papers & Program	Roy Jones
Publicity	Bruce Corwin
Reception	Robert Ford
Registration	Wm. P. "Teddy" Bear
Space Arrangements, Program Properties	Charles Connely
Transportation	Benn J. Hartmann
Sgt. at Arms	Allison B. Clubley
Audio Visual Aids	Sid Meyerson
Regional Vice-President	C. M. Thompson
Chairman, Southern California Section	G. A. Hochenauer

Albuquerque

Host to Inter-Mountain Regional Conference

Very few Regional Conferences will anywhere near match the attendance statistics of the Inter-Mountain Regional held in Albuquerque April 11-12. The slide rule shows that nearly 50 per cent of the entire Region's membership journeyed to Albuquerque for the two-day meeting. Well they might; it was an outstanding program.

First formal paper presented there was of a nature never before scheduled for a Regional Conference, but one which would be of interest in every Region. This was a Progress Report on the Region's membership, given by Brooks Chassaing, Chairman of the National Membership Committee of I.E.S. Far from being a perfunctory statistical report, or a plug for new members, Mr. Chassaing's report was an excellent inspirational talk on the work of I.E.S., and very specifically how that benefits its members. New also to I.E.S. groups were his slides showing charts itemizing all sorts of interesting membership figures for each of the five Sections and Chapters within the Inter-Mountain Region. It was shown, incidentally, that the Arizona Section located in Phoenix and only six years old, is now the largest Section of the Region, towering over even its parent, the Rocky Mountain Section in Denver.

The air conditioning discussion was also a smart thing to have on the program (see complete list of papers at the end of this report). This was the paper on "Lighting and Air Conditioning," by Frank H. Bridgers, the excellence of which is not appreciated from a simple listing of the title. Air conditioning is a conflicting, but mutual problem of lighting and air conditioning engineers. This particular discussion of it was especially practical, and full of pertinent information for illuminating engineers.

Another session designed to bring together conflicting points of view was the Panel Discussion April 12. Its theme: that lighting design may be approached

(*Continued on page* 22A)

Photos courtesy Wm. Cyr, Electrical West

OPENING the Fourth Inter-Mountain Regional Conference, April 11-12, Albuquerque, N. M., Alvarado Hotel. At left, Regional Vice-President, Jerry Whitnell; right, Robert Uhl, Conference Chairman.

(Continued from page 21A)

from a number of different angles, depending on the viewpoint of architect, engineer, fixture designer, supplier and maintenance contractor. With F. A. Dunn serving as moderator, this lively session featured a representative from each of these groups. His own particular function in the interior design was outlined in a 10-minute talk by each of the panellists and the meeting then thrown open to audience participation. Very brisk argument ensued. Pertinent points which did reach agreement: lighting systems, in addition to meeting the principles of good lighting practice, should be movable, flexible and be installed with imagination. The query: can light meters be locally standardized? Lighting systems could well be designed to a percentage maintenance factor. With the usual life of an installation of the order of 15 years, engineers designing a lighting system should think beyond the first installation, and not leave it to deteriorate by itself.

From one who has heard dozens of panels, this was voted one of the best discussions ever put on at an I.E.S. meeting.

Actually, it is misleading to single out any particular part of the technical session for special comment; as will be seen from the detailed program, both days were solid with high calibre discussions. The program chairman is definitely to be congratulated.

MMILJ

Seven entries were featured in the contest for My Most Interesting Lighting Job, under the direction of Albert W. (Bud) Boehning. Three were presented for Class I, Residential; four were Class II, Commercial, contestants. Separate judges were appointed for the two classifications, all of them from distant Regions. For Class I, judges were William Reed, William Shalda, and Ruby Redford. Judging the commercial installations were Carl Allen, Willard Allphin and Marshall Waterman, I.E.S. President. Results:

Class I, Residential

First — Gerald Joseph, New Mexico Chapter.

Second — William Stultz, Southern Colorado Chapter.

Third — Leslie Waggoner, Arizona Section.

Class II, Commercial

First — Robert Uhl, New Mexico Chapter. Lighting telephone buildings.

Second — Gordon McDonald, Rocky Mountain Section. Remodeling Mile High Bank.

Third — Don Roberts, Arizona Section. Outdoor lighting, Valley-Ho Motel.

RESIDENTIAL contestants for MMILJ competition, l. to r., Gerald Joseph, first prize; Les Waggoner, third; William Stultz, second.

Runner-up — Carl Balsic, Southern Colorado Chapter. Exterior lighting of a tower.

President's Luncheon

Marshall Waterman, I.E.S. President, was guest speaker at a luncheon meeting April 11, with George R. Gardner, a past-chairman of the New Mexico Chapter presiding. Mr. Waterman emphasized that Americans are no longer interested in merely having enough light at low cost. They want versatility and other refinements such as were never seen in general use before. Even though four out of five homes are still not properly lighted, growing numbers with modern homes are dissatisfied with ancient lighting. Atmosphere has come to mean more than a romantic luxury, he said. Industry has found that there is a definite advantage in terms of morale and production when lighting is right. Stressing a third dimension of "pleasantness" in addition to the values of quantity and quality, Mr. Waterman noted that it is the business of the Illuminating Engineering Society to concern itself with the art as well as the science of lighting. In its 51 years of existence, he said, I.E.S. has not only attempted to determine the guide rules and principles of good lighting practice, but to make its recommendations available to the public and to encourage the application of these principles.

Socially

Several of the papers on the technical schedule were of particular interest to the some 30 ladies attending this conference. So their own program was timed to allow their attendance at the presenta-

(Continued on page 25A)

COMMERCIAL contestants in the contest: in the usual order, Don Roberts, Robert Uhl (winner), Les Johnson (proxy for Carl Balsac), and Gordon McDonald.

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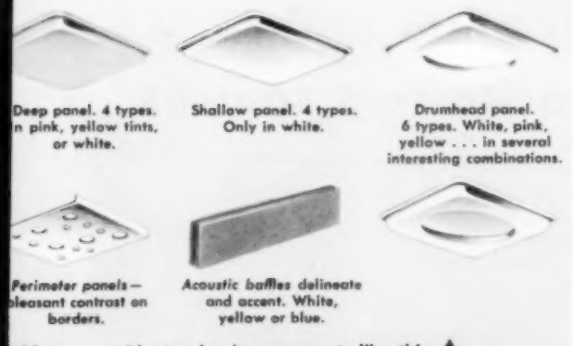

Deep panel. 4 types. In pink, yellow tints, or white.

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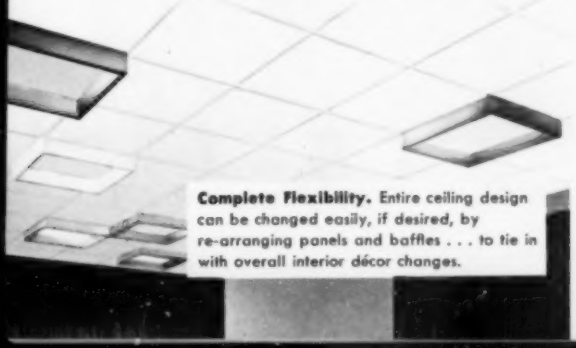

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With new Sylva-Lume, the ceiling area has been rediscovered as the logical medium for the contemporary imagination. Unlimited freedom of design now lies at your fingertips. You can custom-create *over 100,000 different lighting patterns* . . . using only a few standardized components . . . based on 36-inch modules.

Sylva-Lume brings more of *you*, your own individuality, into your interiors. Organize its elements of color, light, and form . . . get pattern, texture, mood and style, as you wish.

This dynamic new lighting system was developed by a creative group, for a creative profession. Sylvania engineers assisted by Peter Muller-Munk Associates, noted industrial designing firm, brought this artistically conceived creation into the realm of engineering practicality. *Write direct for folder of complete information.*

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Cross-sectional diagram shows the concave shape of the prismatic surface. Prisms are effective over entire surface of this Corning Lenslite.

Incandescent lighting with Corning's Concave Lenslites gives unusual brightness control and uniform illumination in the St. Francis Xavier School, Wilmette, Illinois. Fixtures by Curtis Lighting, Inc.; Architect—Henry Rothschild of Belli and Belli.

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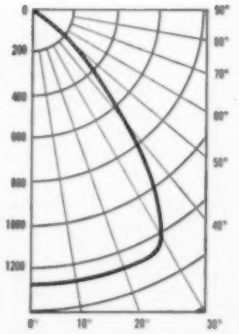

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PANEL discussion was an especially stimulating feature of the conference. Participants were, l. to r., Gerald Joseph, contractor; D. P. Schlegel, architect; Moderator F. A. Dunn; J. Joseph Lopez, consulting engineer; and Lyle M. Bailey, fixture manufacturer.

tion especially of "Garden Lighting" by Bill Shalda, and "Decorating with Light" by Byron G. Payne. Rather close timing was required because the rest of their program never lagged. Starting the first day, April 11, they joined car pools to drive out 20 miles for luncheon at La Casa de las Huertas, in Placitas, New Mexico. Here they saw a showing of Fiesta fashions which included designs of Indian and old Spanish origin, and typical New Mexico fashions. They met again the following day for a shopping tour of Old Town Plaza, and of course, joined the men for the President's Reception and Banquet Friday evening.

A most entertaining feature of the banquet was a talk, in his own inimitable fashion, by Bill Cyr, Consulting Editor of *Electrical West*. His subject, "Research Projects Needed — But Good!"

There were two presentations made during the banquet, in addition to the MMILJ checks. President and Mrs. Waterman received gifts from the Region, selected especially to commemorate their stay in New Mexico. Mrs. Waterman received hand-made Indian earrings; to President Waterman, silver and turquoise cuff links, also Indian made.

Les Johnson, Chairman of the Southern Colorado Chapter, host to the Conference next year, received a surprise gift: all of the signs used in connection with this Conference were collected and presented to him, for use at next year's Conference in Pueblo. They have already served well; New Mexico Chapter put on a smoothly-run meeting.

This whole affair wound up with a dance — Fiesta fashion, indeed.

Technical Program

Full details of the Conference program were:

General Session — J. D. Whitnell, Presiding
Introduction of Officers and Guests — Robert J. Uhl, Conference Chairman.
Welcome to Albuquerque — Maurice Sanchez, Chairman, City Commission.
Response — J. D. Whitnell, Regional Vice-President.
Progress Report on Members — Brooks Chassaing, Chairman National Membership Committee.

Technical Session No. 1

Leonard J. Carlon, Chairman Rocky Mountain Section, Presiding

The Use and Misuse of Maintenance Factors — Willard Allphin, Sylvania Electric Products Inc., Salem, Mass.
Recent Developments in Light Sources in Optical Systems for Roadway Lighting — E. B. Karns, Westinghouse Lighting Division, Cleveland, Ohio.
Lighting and Air Conditioning — Frank H. Bridgers, Bridgers and Paxton, Consulting Engineers, Albuquerque, N. M.
Luncheon — Alvarado Hotel. George R. Gardner, Past Chairman N. M. Chapter, Presiding. Speaker — Marshall N. Waterman, President of I.E.S., and Westinghouse Lamp Division, Bloomfield, N. J.

Technical Session No. 2

John F. Gohring, Chairman Arizona Section, Presiding

High Frequency and High Footcandles — Carl J. Allen, General Electric Co., Nela Park, Cleveland, Ohio.
Hi-Cycle, Hi-Voltage U.N.M. Gymnasium Lighting — Carl R. Albach, Consulting Engineer, Santa Fe, N. M.
My Most Interesting Lighting Job Contest — Albert W. Boehning, Jr., Chairman.
Inspection Trips of Albuquerque Lighting — Evening.

Technical Session No. 3

Earl Don Peterson, Secretary, Utah Section, Presiding

Using Fixture Test Data — James H. McCulloch, Independent Testing Laboratories, Boulder, Colo.
Garden Lighting — William Shalda, Shalda Manufacturing Co., Burbank, Calif.
Panel Discussion — Topic: Lighting Design As I See It.
Moderator: F. A. Dunn, Manager, G. E. Supply Co., Albuquerque, N. M.
Architect-Engineer: Don P. Schlegel, Asst. Prof. of Architectural Engineering, University of New Mexico.
Engineer: J. Joseph Lopez, Uhl and Lopez, Consulting Engineers, Albuquerque, N. M.
Fixture Designer: Lyle M. Bailey, Vice-President, Albert Sechrist Co., Denver, Colo.
Maintenance Contractor: Gerald Joseph, Lighting and Maintenance Co., Albuquerque, N. M.

Technical Session No. 4

Robert F. Even, Chairman Southern Colorado Chapter, Presiding

Design of a Luminous and Living Environment — C. L. Crouch, Technical Director of I.E.S., New York, N. Y.
The Dilemma of Quantities — Max Flatow, Architect, Albuquerque, N. M.
Fluorescent Floodlighting — John C. Epperson, J. C. Epperson Co., San Francisco, Calif.
Decorating with Light — Byron G. Payne, Arizona Public Service Co., Phoenix, Ariz.
Aims in Stage Lighting — Gregg N. Cloos, Manufacturers Representative, Denver, Colo.
Closing Remarks — Robert J. Uhl, Conference Chairman.
President's Reception and Banquet. Guest speaker, William A. Cyr, Consulting Editor, *Electrical West*, San Francisco, Calif. Subject — "Research Projects Needed — But Good!"

PROGRAM chairman Carl R. Albach, right, discusses paper with one of his speakers, E. B. Karns, Westinghouse, Cleveland, Ohio.

Credit Due

Congratulations are in order to all in the New Mexico Chapter for the outstanding success of this Conference, and

(*Continued on page* 26A)

TO ALL I.E.S. MEMBERS:

With this letter I want to bring to the attention of each of you the most important event in the Society's annual program... The National Technical Conference, September 9-13.

This year the conference is being held in Georgia at the Atlanta Biltmore Hotel. Those of us whose society's activities have spanned the past 15 years will recall that this was the scene of a most memorable convention in 1941. We feel sure that our Southern hosts will again display the same hospitality in 1957. Whereas, the papers presented in '41, however, were based on lighting for defense and war production, the discussions this year will cover the latest in lighting developments, and their applications in a period of peace and prosperity.

In addition there will be the comprehensive report of the Lighting Progress Committee, and the final competition in the "My Most Interesting Lighting Job" contest. A special forum devoted to Residential Lighting is also scheduled.

Your attendance at the Atlanta conference will not only be an experience in professional self-development, but also a contribution to the future of illuminating engineering. The discussions of the technical papers and the personal contacts with other leaders in the lighting industry can be of enormous benefit to all.

I urge you all to attend.

Cordially yours,
MARSHALL N. WATERMAN
President

(*Continued from page* 25A)

in particular to the following committee chairmen who guided it:

Conference Committees

Chairman — Stanley Bazant, Jr.
Vice-Chairman — Carl R. Albach

Executive Committee

Regional Vice-President — J. D. Whitnell
Chairman — Robert J. Uhl
Vice-Chairman — Robert Detzler
Honorary Vice-Chairman — Robert King
Secretary-Treasurer — Fred Dunn

Committee Chairmen

Finance — Fred Dunn
Registration & Reception — E. T. McGillan
Papers & Programs — Carl R. Albach
Entertainment — Joe Pearce
Attendance & Publicity — J. Joseph Lopez
Most Interesting Lighting Job — Bud Boehning
Hotel Arrangements and Transportation — Robert Detzler, Ted Douglass
Decorations — Gerald Joseph
Ladies Committee — LaVerne Knudtson

Inter-Mountain Region

J. D. Whitnell — Regional Vice-President

Arizona Section

Chairman — John F. Gohring
Secretary — Robert E. Tweedy

New Mexico Chapter

Chairman — Robert J. Uhl
Secretary — J. Joseph Lopez

Rocky Mountain Section

Chairman — Leonard J. Carlon
Secretary — Leigh Congdon

Southern Colorado Chapter

Chairman — Robert F. Even
Secretary — Les Johnson

Utah Section

Chairman — Wayne F. Mulcock
Secretary — Earl D. Peterson

Allied Arts Activity for New England Section

Under the chairmanship of Eugene Frost, the New England Section has launched an Allied Arts activity at the Boston Architects Club, Boston Architectural Center. In this activity the I.E.S. Section is collaborating with Arcangelo Cascieri, Dean of the School of Architecture.

The initial group of students and about twenty members of the BAC staff and I.E.S. Board members and officers met March 18 for their first meeting, with Carleton Holden as Chairman. Karl A. Staley, General Chairman of the Allied Arts Committee addressed the group during the two-hour session, and the students were given a problem to be completed in five weeks. The problem undertaken concerned the relighting and redecorating of a small library of the Architectural Center. I.E.S. members worked directly with the class during the five-week program; a jury of judges selected the winners.

Three winning students presented their rendus and explained them at the New England Section meeting April 8. All of the competing designs were displayed at this meeting, and excited numerous favorable comments. The Education Committee of the Center will present the prize winners with I.E.S. checks for first, second, and third place — $25, $15, and $10 — at the June Annual Awards Banquet of the Architectural School.

A move to organize another program next year is now being considered. The New England Section is convinced from the success of this first program that the Allied Arts activity is a most constructive project. Rewards, they feel, are numerous — in I.E.S. prestige and recognition, and in the opportunity of making an educational contribution to architectural students.

Awards Made to Architectural Students, U. of Cin.

Awards in the Illuminating Engineering Society Competition for Junior Architectural students at the University of Cincinnati were announced by Val McCluskey, Chairman of the Ohio Valley Section at a luncheon meeting held at Hotel Sinton, Cincinnati, Ohio, on April 15, 1957.

Two top prizes of $50 each were won by Herbert Lawton and Charles Stark. Two second prizes consisting of IES Lighting Handbooks were awarded to Benjamin Thaddeus and Robert Cooper. Certificates of honorable mention were given to Robert Beckley, Lonnie Overton and Douglas Meyer.

The competition, established by the Ohio Valley Section in 1955, was designed to emphasize the value of lighting as an architectural tool and to bring a knowledge of its use as such to the Architectural student.

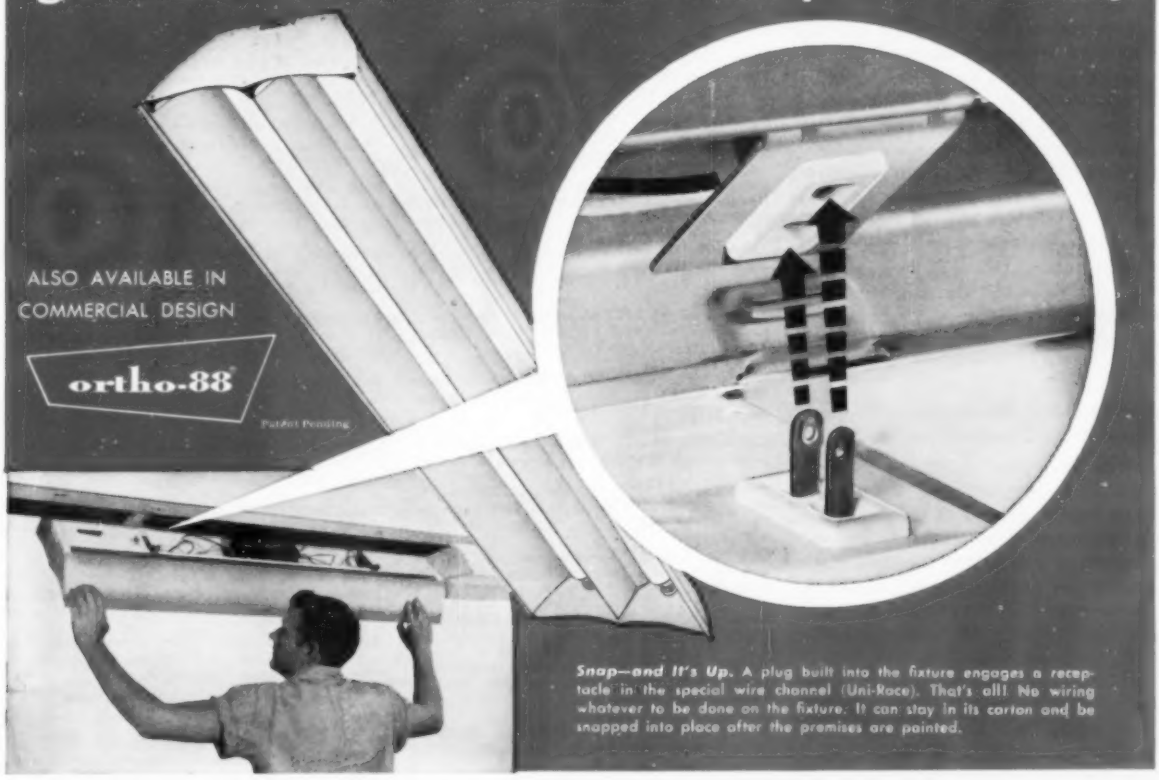
The problem for the 1957 Competition was the design of a student chapel including the effective and dramatic use of light in the design.

Judges were Professors Robert W. Dayton and Robert Deshon of the University staff and Robert W. Brown representing the Illuminating Engineering Society. Mr. Brown, Chairman of the local Allied Arts Committee was assisted by IES members, Harold J. Gruber, Leonard P. Cohron and Ronald L. Campbell.

(*Continued on page* 28A)

THE FIXTURE THAT JUST PLUGS IN

gives lowest-cost installation... unequaled flexibility



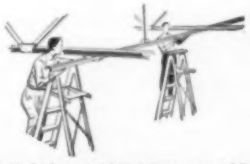
Snap—and It's Up. A plug built into the fixture engages a receptacle in the special wire channel (Uni-Race). That's all! No wiring whatever to be done on the fixture. It can stay in its carton and be snapped into place after the premises are painted.

Because the Gibson Ortho eliminates so many of the time-taking operations common to conventional installations, it easily saves more than 50 percent in installation costs. Many contractors report that all labor, including branch circuit wiring, stems and lamping, averages only 17 to 22 man-minutes per fixture. Complete flexibility is another reason for this unique fixture's growing popularity. The Ortho can be mounted in continuous rows or at intervals of 4, 8, 12 or more feet, and re-spaced at any time without tools. A four-light fixture can be replaced with a two-light fixture and vice versa.

There's a lot more you should know about this remarkable fixture. Won't you let us send you complete descriptive literature? Drop us a line today.

3 SIMPLE STEPS TO INSTALL THE ORTHO

1 Telescoping sections of Uni-Race assembled and wired on the floor.



2 Light but rigid Uni-Race assembly, up to 24', easily lifted and hung.

3 Fixtures snap into place in seconds without tools. No wired connections.

Patent Pending

Gibson LIGHTING

GIBSON Manufacturing Co.

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MAKERS OF THE NEW Ceilo•35 WORLD'S THINNEST FIXTURE WITH NO DARK AREAS

IN CANADA manufactured under franchise by one of Canada's oldest and largest manufacturers of lighting fixtures ELECTROLIER MFG. CO. Ltd., Montreal

(*Continued from page* 26A)

In addition to presenting several critiques during the two-week problems, the local Section also sponsored a one-day trip for the students to the General Electric Lighting Institute at Nela Park, Cleveland, Ohio.

Both students and faculty at the University of Cincinnati are becoming increasingly aware of the value of lighting in architecture as a result of these competitions and the Ohio Valley Section suggests that other sections and chapters throughout the country might profitably investigate the possibility for conducting similar programs. This sort of educational program also fulfills one of the purposes of the IES, that of disseminating information for the purpose of promoting safety, comfort and happiness of mankind through the provision of good light.

Million-Dollar Engineering Center Planned for Cleveland

With an anchor to windward in the form of the largest money commitment of its type to be made in Cleveland since the depression days of the 1930's, construction of a $1,525,000 Cleveland Engineering and Scientific Center on Chester Avenue near East 30th Street will begin immediately, according to news received from Cleveland Engineering Society.

Exemplifying the growth and importance of engineering in the industrial northeastern Ohio area, the new structure will provide adequate meeting facilities for more than 53 engineering and technical groups and through its overall program of individually organized activities will be a Center for continuing technical education.

Although the Building Fund campaign is still short of its goal, the decision to proceed immediately with construction was made by the Board of Governors of the Cleveland Engineering Society, owners and operators of the building, after urgings by industrial and community leaders and by representatives of member groups of the Cleveland Technical Societies Council, a cooperating body of more than 50 local chapters of national groups with a total membership of an estimated 13,000 engineers, architects, scientists and other technical specialists.

Turning point in the consideration of whether to proceed now with construction or to wait until more funds were raised was an expression of faith in the engineering profession and in the future of Greater Cleveland from banking circles. More than 250 companies and 3,500 individuals have participated in the program with additional new pledges being received every day.

Over the past three years many outstanding industrial leaders have been identified with the fund raising campaign. They include: Roscoe H. Smith, secretary, Reliance Electric & Engineering Co.; Warner Seely, vice president, Warner & Swasey Co.; Sam Littlejohn, commercial vice president, General Electric Co.; Carlton R. Sabin, partner, Sabin Engineering Co.; and Julius C. Strasbourger, general supervisor, Illuminating Co.

The Executive Committee guiding the campaign consisted of: Clarence J. Beller, William Benninghoff, Albert Casey, G. Brooks Earnest, Clarence W. Fick, Harry Gellin, Joseph H. Gepfert, William R. Hough, Benjamin A. Smith, Seely and Chase.

Initial phase of construction of the new Center has already started with the demolition of existing buildings. Ground breaking ceremonies were held on the Chester Avenue site Wednesday, April 24th and occupancy is expected during the summer of 1958.

The Cleveland Engineering and Scientific Center will have approximately 50,000 sq. ft. of floor space or about three times the space now available at the Cleveland Engineering Society's present

(*Continued on page* 31A)

SCHEDULED EVENTS

June 13-14, 1957 — Northeastern Regional Conference, Illuminating Engineering Society, Hotel Statler, New York, N. Y.

June 14, 1957 — Society of Plastics Engineers, Regional Technical Conference, Lowell Tech. Inst., Lowell, Mass.

June 24-27, 1957 — American Society of Heating and Air-Conditioning Engineers, Murray Bay, Quebec, Que.

June 24-28, 1957 — American Institute of Electrical Engineers, Summer General Meeting, Montreal, Que.

August 28-30, 1957 — American Institute of Electrical Engineers, Pacific General Meeting, Yakima, Wash.

September 9-13, 1957 — Illuminating Engineering Society, National Technical Conference, Biltmore Hotel, Atlanta, Ga.

September 24-26, 1957 — Institute of Traffic Engineers, Statler Hotel, Detroit, Mich.

October 4-9, 1957 — Society of Motion Picture and Television Engineers, Hotel Sheraton, Philadelphia, Pa.

October 5-8, 1957 — International Association of Electrical Leagues, Sinton Hotel, Cincinnati, Ohio.

October 7-9, 1957 — National Electronics Conference, Inc., Hotel Sherman, Chicago, Ill.

October 7-11, 1957 — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

October 9-11, 1957 — Canadian Electrical Manufacturers Associaiton, Sheraton-Brock Hotel, Niagara Falls, Ont.

October 21-25, 1957 — National Safety Council, 45th National Safety Congress & Exposition, Chicago, Ill.

October 26-31, 1957 — National Association of Electrical Distributors, (Semiannual Meeting), Edgewater Beach Hotel, Chicago, Ill.

October 27-30, 1957 — National Association of Electrical Distributors (Board of Governors), Skytop Lodge, Skytop, Pa.

Week of November 10, 1957 — National Electrical Contractors Association, Cincinnati, Ohio.

November 11-15, 1957 — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

November 18-21, 1957 — 10th Exposition of the Air-Conditioning and Refrigeration Industry, Navy Pier, Chicago, Ill.

December 1-6, 1957 — The American Society of Mechanical Engineers, Annual Meeting, Hotel New Yorker, New York, N. Y.

January 20-24, 1958 — American Institute of Electrical Engineers, Winter General Meeting, New York, N. Y.

January 27-29, 1958 — American Society of Heating and Air-Conditioning Engineers, Incorporated, Annual Meeting, Pittsburgh, Pa.

March 2-5, 1958 — National Electric Sign Association, National Convention, Shamrock Hilton Hotel, Houston, Texas.

June 9-13, 1958 — National Association of Electrical Distributors, 50th Annual Convention, San Francisco, Calif.

June 23-27, 1958 — American Institute of Electrical Engineers (Summer General Meeting), Buffalo, N. Y.

August 17-22, 1958 — Illuminating Engineering Society (National Technical Conference), Royal York Hotel, Toronto, Canada.

August 19-22, 1958 — American Institute of Electrical Engineers, Pacific General Meeting, Sacramento, Calif.

October 13-15, 1958 — National Electronics Conference, Inc., Hotel Sherman, Chicago, Ill.

October 20-24, 1958 — National Safety Council (46th National Safety Congress & Exposition), Chicago, Ill.

October 27-31, 1958 — American Institute of Electrical Engineers (Fall General Meeting), Pittsburgh, Pa.

November 10-14, 1958 — National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

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LINE OF INCANDESCENT LIGHTING FIXTURES

PLEASE HELP ME— I NEED A NAME!

I'm your new LUMEN-ATIONS friend, from the sunny shores of far-away and long-ago Greece, and I'm a direct descendant of the famous old Diogenes.

After looking *everywhere* for the world's finest incandescent lighting line, I finally found it—at Guth. So I've gone to work as a silent salesman for Guth, and you'll be seeing a lot of me—in national ads, literature, premiums, point of sale material, conventions, in all sales promotion and merchandising campaigns, pointing out the features and qualities of the Guth Brascolite incandescent line.

There's just one thing wrong—I don't have a name! Will you help name me, please? Just send in your suggestions—as many as you wish—to the Guth address below. The senders of the five best names will each receive . . .

φιάλην τοῦ οἴνου

(a bottle of Metaxa, an excellent Greek brandy)

Quality is the word for this new Guth Brascolite incandescent fixture line with Alzak aluminum reflectors. Stylish design, sound engineering, efficient function . . . a real boon to the architect, electrical engineer and all who specify lighting.

And here's another terrific working tool—the new Brascolite catalog. Contains *everything* you need to figure any incandescent lighting job. Write today on your letterhead for your complimentary copy.

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As Important as the Right Note in a Symphony —THE RIGHT LIGHT

When you never know just what the light level should be — until you try it — when the light level should change to match an occasion or to meet a mood . . . *then you should specify* LUXTROL *light control equipment.*

The dimming, brightening, blending of light is no longer the monopoly of the auditorium. It has made "off-on" lighting not only old fashioned but also uneconomical.

"All-level" lighting is making money for restaurants, cocktail lounges, hotels, stores — wherever people gather and the right mood or the right appearance can increase the money they will spend.

Light control has become the fourth dimension not only of the interior decor but also of the merchandise.

LUXTROL light control equipment can be used on incandescent, fluorescent and cold cathode lamps. In the complete line are units to meet all requirements from 360 to 30,000 watt loads. Send coupon below for more information on sales possibilities for LUXTROL light control equipment.

JUST DIAL THE RIGHT AMOUNT OF LIGHT FOR:

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THE TYPE OF MEETING

THE TIME OF DAY

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Non-Interlocking Types When only a few circuits require control. Capacities from 1000 to 30,000 watts.

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Type WSD 360 A compact unit designed to replace the ordinary "on-off" switch in a wall. 360 watt rating.

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building, a remodeled telephone exchange, at 2136 East 19th St.

The Center will have an auditorium to accommodate 150 people; a main dining room serving 350 people and three special dining-meeting rooms and class rooms. The auditorium, and an adjacent future dining room, are designed for heavy loading for exhibition purposes. Office space is also available for society offices, and special services, such as mailing and duplication, will also be offered.

Back Issues of IE Available

Back numbers of ILLUMINATING ENGINEERING complete from December 1949 are being offered for sale at 25 cents a copy. William P. (Teddy) Bear, a Member Emeritus of I.E.S. is offering the entire lot to anyone wishing to complete his lighting reference library. Inquiries should be addressed to:

Wm. P. Bear
8344 Lullaby Lane
Panorama City, California.

Engineers Seen As Source of Future Managers

Engineers will be one of the primary sources for management personnel of the future, it was predicted recently. This will be because of his training and the increasingly complex nature of modern civilization, A. J. Morgan, of the University of Dayton Research Center told a symposium on management during the East Central and Middle Eastern District Meeting of the American Institute of Electrical Engineers.

"There is a vital interest in continuing the technological advances in modern civilization," he said in a paper, The Development of Management Capabilities Among Practicing Engineers. "This interest stems not only from the comfort that these advances have given civilization, but from preserving what has been gained and what might be gained. In this endeavor that currently exists and will exist in the future, there is a requirement for the development of manpower in many fields. In the future, the requirement might well be beyond our present comprehension. If such an interest in technological advances continues to exist, this endeavor will require well trained and qualified management personnel. Since the modern way of life becomes more complex, it follows that the leadership necessary must have a greater technical background than was required in the past. Therefore it becomes apparent that one of the primary sources for the future management personnel is in the engineer."

Basically, he continued, the necessary qualities for management are fundamental intelligence, emotional stability, an understanding of people combined with ability to cope with their problems, integrity, health and enthusiasm.

These, he said, are fundamental, but the following executive skills are required of the true manager: Logical thinking, creative thinking, sense of money, organization of time and social sensitivity.

The engineer, by reason of his training, possesses at least three of these fundamentals, fundamental intelligence, logical thinking and creative thinking and thus "maintains a distinct advantage over other candidates for a managerial position," he observed.

Plans Developed for 1958 National Electrical Week

After a review of the results of National Electrical Week for 1957, the N.E.W. Committee has announced plans for an even more far-reaching observance during the week of February 9-15, 1958.

The committee, representing the twelve sponsoring trade associations, held its review meeting in Chicago in advance of the annual sales conference of the Edison Electric Institute's commercial division. Chairman Merrill E. Skinner reported that 177 reports, at state and local level, covering activities during the "Week" had been received.

1958 N.E.W. materials will be distributed to national advertisers and key industry representatives during the coming summer and early fall, according to present plans. As in 1957, the project will be carried out as an "umbrella activity" —a beginning of the year springboard for various programs and educational or promotional objectives to focus attention on the contributions of electricity to our way of life.

ASEE To Study Engineering Faculty Needs

A $10,000 grant of the National Science Foundation will support the first phase of a comprehensive study of how American engineering colleges may attract and keep top-flight engineering teachers for their growing numbers of students.

The American Society for Engineering Education, sponsor of the project, says the grant will be used for preliminary work on a study "to determine and describe in detail the character and magnitude of the manpower and related financial needs of engineering colleges" and for organizing a full-scale attack on the problem.

When these needs are better understood, the Society's project will go on to identify and specify the problems to be solved in meeting these needs, to determine and describe the special opportunities, satisfactions, and problems of engineering teaching, and to formulate the conditions which engineering colleges must fulfill to attract and develop good teachers for their faculties.

The ASEE project, titled officially "The Development of Engineering Faculties," is under the direction of an executive committee of which Dean Harold L. Hazen, of the Graduate School of Massachusetts Institute of Technology, is chairman. Dr. William H. Miernyk of Northeastern University is Executive Director. The facilities of Northeastern's Bureau of Business and Economic Research will be used.

Address Changes should be reported to I.E.S. Headquarters by the first of any month, to insure the uninterrupted mailing of I.E. and other Society communications.

Winners Announced N. Y. Section Architectural Contest

Prizes for New York Section's Architectural Competition were awarded April 25, at a dinner meeting held at the Architectural League, New York City. The contest, under the chairmanship of Rollo Gillespie Williams, Century Lighting Inc., attracted large numbers of architectural students from several New York schools of architecture. The problem for which they competed was to design the lighting for a Women's Specialty Shop on Park Avenue in the fifties.

First prize went to Miss Cordette McCracken of the Architectural School of Pratt Institute. In addition to a cash award of $50.00, Miss McCracken won a year's Student Membership in I.E.S., and a copy of the *IES Lighting Handbook*.

Second prize, $30.00 plus Student Membership and Handbook went to Timothy Sullivan, also of Pratt Institute.

Third prize, $20.00 plus Student Membership and Handbook, was awarded to Jerome Kerner of Pratt, and fourth prize of membership, Handbook and $10.00, to Herbert Stone, School of Architecture, Pratt. There were three honorable mentions: Robert Loren Rotner of Columbia University School of Architecture, Robert Keller, Pratt and Alexis Yermakov, also of Pratt.

A jury of judges selected these young winners from a group of excellent entries. Judges were: Edward F. Kook, Century Lighting Inc., Chairman; Berlon Cooper, Eastern Editor of *Electrical Con-*

(Continued on page 32A)

(*Continued from page 31A*)

struction and Maintenance; Robert de Verac, Lippincott & Margulies, Designers; Worthen Paxton, architect, John Graham & Company; Frank Gina, architect, Ketcham, Gina & Sharp; and W. Fred Noyes, architect.

Lighting Conference Held For Architects

A three-day educational conference for architects met April 24-26, at the Lighting Institute of General Electric Company, Cleveland, Ohio. Illumination problems with demonstrations of practical solutions brought to the architects' attention many new practices in lighting. Details of the "curricula" included:

Seeing in the Schoolroom — A resume of Forty Years of Lighting Research.
Lighting Terms and Fundamentals.
Demonstration and Discussion of Classroom Lighting Techniques.
Lamps Commonly Used in Schools.
Comfortable Lighting — Factors Inherent in Quality.
Need for Proper Wiring in Schools.
Lighting for Study at Home.
School Shop Lighting Requirements.
Library Lighting.
Auditorium and Stage Lighting.
Offices and Drafting Rooms.

Frank D. Wyatt Dies Fellow of I.E.S.

Chicago Section has reported the loss of one of its most illustrious members, in the death last month of Francis D. Wyatt, nationally recognized street lighting engineer. Mr. Wyatt, 67, was for many years engineer in charge of design, construction and operation for the Chicago Park District.

Mr. Wyatt's long list of achievements in illumination, particularly in street, highway and sports lighting, includes many new developments for these fields. To him is credited the development of aluminum poles for street lighting; the design, construction and development of an illumination laboratory, including photometers for the Chicago Park District; a new approach to sports floodlighting with his installation at Soldiers Field in 1946; research on pavement texture and brightness; design and installation of one of the first mercury and incandescent lighting systems in Columbus, Ohio, in 1935.

For many years Mr. Wyatt served the Society as member and Chairman of the Committee on Street and Highway Lighting, the Sports Lighting Committee and as the Society's Official Representative to the President's Highway Conference

F. D. Wyatt

and was the author of numerous papers on street lighting research. In 1954 he was elected Fellow of I.E.S., in recognition of his notable original work in illumination.

ABOUT PEOPLE

Walter C. Granville, formerly assistant director of design for the Container Corp. of America, has established an independent practice as color consultant and has been retained as staff color consultant to the Chicago design firm, Design Dynamics, Inc.

Joseph F. Watkins, Supervisory Engineer for the General Electric Large Lamp Dept.'s New York sales office, retired May 1 after 33 years in the lighting industry. Mr. Watkins began his career in 1924 as sales engineer with the Cooper-Hewitt Electric Co., a former G-E subsidiary in Bridgeport, Conn. He served as district manager of the Bridgeport sales office until 1942, when he moved to the New York sales office, where in recent years he has supervised the engineering staff.

James H. Jewell, vice-president in charge of sales for Westinghouse Electric Corp., has been appointed to the new post of vice-president in charge of marketing. In addition to his current responsibilities for sales, advertising, market research, and sales training and planning, Mr. Jewell will assume the direction of the company's new distribution services department.

Election of **Harold S. McCullagh** as treasurer of Curtis Lighting, Inc., Chicago, has been announced. Mr. McCullagh, formerly controller, fills a post vacant for several years. He joined the company in June 1955, coming from Illinois Tool Co., where he was a budget director.

The Large Lamp Department of the General Electric Co., has announced five new regional sales offices. Managers of these offices and their regions are: **Everett G. Agee,** Eastern Region, New York, N. Y.; **Douglas B. Clark,** Southern Region, Atlanta, Ga.; **Frederick F. Denny,** Midwestern Region, Chicago, Ill.; **Joseph M. Lime,** East Central Region, Cleveland, Ohio; and **Donald D. Scarff,** Western Region, San Francisco, Calif. The number of sales districts reporting to each regional sales manager ranges from five to eight.

The Wakefield Co. has expanded its method research and application facilities in high frequency engineering, now centered in the Architects' and Engineers' Service Dept. at Vermilion, Ohio. The department, headed by **R. H. Horner,** does application engineering for installations in this country and for Wakefield Lighting Limited, London, Ont. **R. D. Burnham,** with whom Mr. Horner collaborated in his work, is opening offices for consulting services and will be retained by Wakefield on specific projects.

Century Lighting, Inc., has appointed **Henry Kogel** as Sales Engineer, to be working entirely in the field of lighting for television. Mr. Kogel was formerly Staff Engineer for the Society of Motion Picture and Television Engineers. He is succeeded in his SMPTE post by **J. Howard Schumacher, Jr.,** who had been Laboratory Technician with NBC Development.

Appointment of **John J. Nolan** as chief industrial engineer has been announced by Curtis Lighting Inc. Mr. Nolan joined Curtis in 1955, coming from the Liquid Carbonic Corp.

Theodore Ake, Jr., has joined The Miller Co., Illuminating Division, as Application Engineer. Mr. Ake was formerly lighting engineer and salesman in the Commercial Sales Dept. of The Cleveland Electric Illuminating Co.

The Miller Co. also announces the appointment of seven sales representatives: **James G. Terry** in Alabama; **Olin R. Wood** in North Florida and South Geor-

(*Continued on page 45A*)

Now . . CUSTOM PLASTIC PANELS

FOR THE **AREA/LITER**® AND MODU/LITER

Designed to your Special Order

FOR ALL COMMERCIAL USES

Custom designs in plastic panels offer the distinction required in modern architecture. No need to sacrifice architectural theme and design at the final point of selecting plastic panels. Not just standard designs to choose from but your own design executed at our factory to enhance perfection and bring to reality an overall architectural tone.

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SOUTH SAN FRANCISCO: 352 SHAW ROAD
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New! LOW COST LUXURY FOR MODERN LOW CEILINGS

metco Lighting

WRAP-AROUND

PlastoLier

SURFACE OR PENDANT MOUNTING

Shallower! *Only* **3½"** *deep*

smart modern one-piece

Wrap-Around Shielding

of extruded EVER-WHITE polystyrene

All-Welded 1-Piece Body

Light Weight

Complete 2-lamp unit weighs **17** *lbs. shielding alone* **2½** *lbs.*
Complete 4-lamp unit weighs **25** *lbs. shielding alone* **3½** *lbs.*

BUILT-IN UPLIGHTING

when mounted as a suspended unit. Designed for individual installation or continuous runs. Available in 2 and 4-lamp sizes, each 4-ft. long. Write for prices and catalog sheet.

Certified Lighting for a Better America

Certified FLEUR-O-LIER CERTIFIED

Sold only through qualified electrical distributors

METALCRAFT PRODUCTS COMPANY, INC., Mascher and Lippincott Streets, Philadelphia 33, Pa.

Solving tough beam control problems with Kopp *specially-designed glass*

Modern glass has many useful properties which when properly engineered provide highly-desirable products for industrial use.

Kopp engineers proportion and mix these properties, as a chef creates a new recipe, to provide an innumerable family of quality products. They are then put through a series of exacting tests—some to destruction—to determine their maximum application values. Production, the same as designing, is carefully controlled to assure products of utmost dependability and performance.

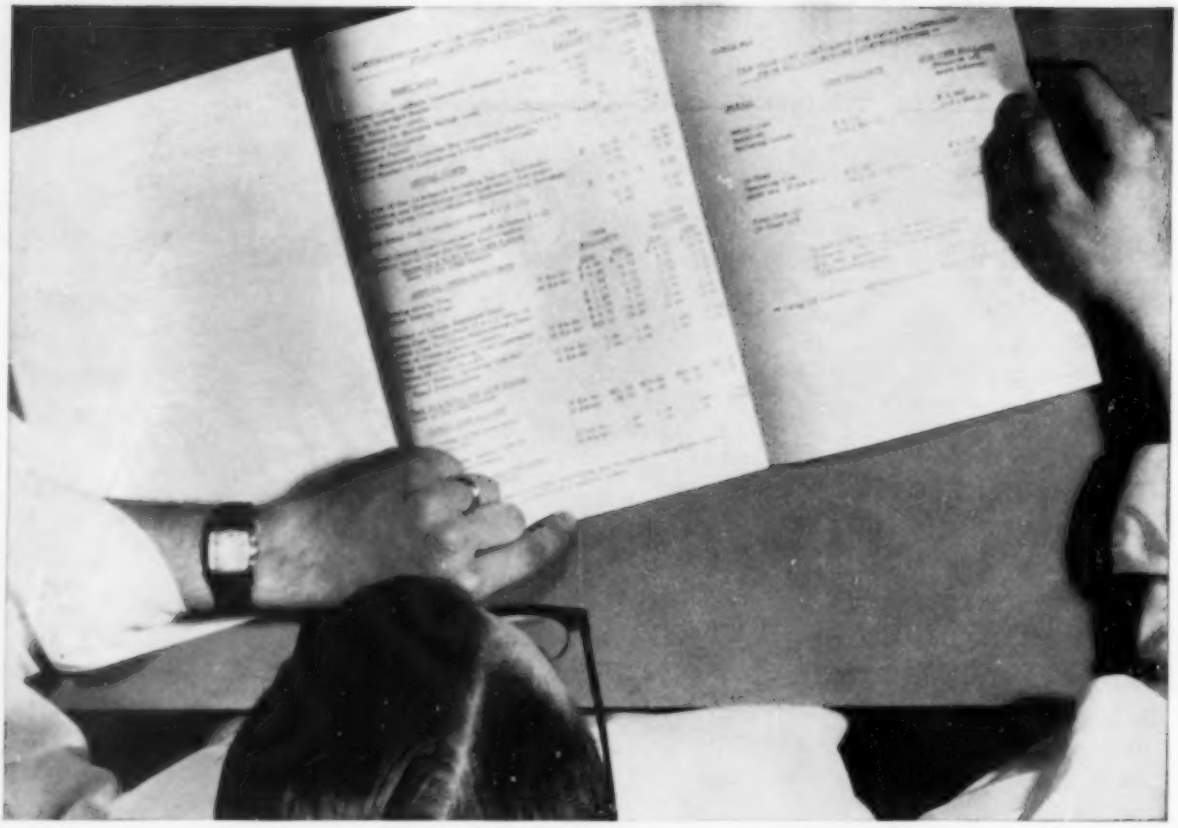
Through the years, our engineering department has developed over 1000 glass items utilizing over 100 varieties of glass. Some were designed to concentrate a beam of light within a limited area, others to diffuse light over a broad area or direct portions of it to definite paths.

Call us today about your specialized glass needs. Our engineering department will be glad to help you.

KOPP GLASS

KOPP GLASS, Inc.

Swissvale, Pennsylvania



This report proves it costs many dollars more for the non-certified ballast you buy for a few nickels less

Certified Ballast Manufacturers, cooperating with lamp manufacturers, have set rigid standards for fluorescent ballast performance. A ballast that meets or exceeds minimum CBM specifications assures you rated lamp life and full light output, cool operation, reliable striking, and long ballast life. It carries a diamond-shaped CBM emblem. Without CBM specifications, there would be *no* standards for performance . . . no floor under quality.

Sola ballasts for general lighting applications meet or exceed CBM specifications or proposed specifications wherever they exist. Sola has no "secondary line" that does not meet the accepted minimum standards. Sola ballasts carry both the UL (Underwriters' Laboratories) emblem and the CBM emblem.

Other manufacturers are now making ballasts which are not designed to meet CBM standards. These ballasts bear only the UL emblem. In order to save a few cents, many people are using these ballasts, apparently under the impression that the UL emblem assures satisfactory lamp performance. *It does not.* UL performs valuable, but highly specialized tests, for *safety* only. UL does *not* test for operating characteristics that assure efficient, economical lamp performance and long lamp life.

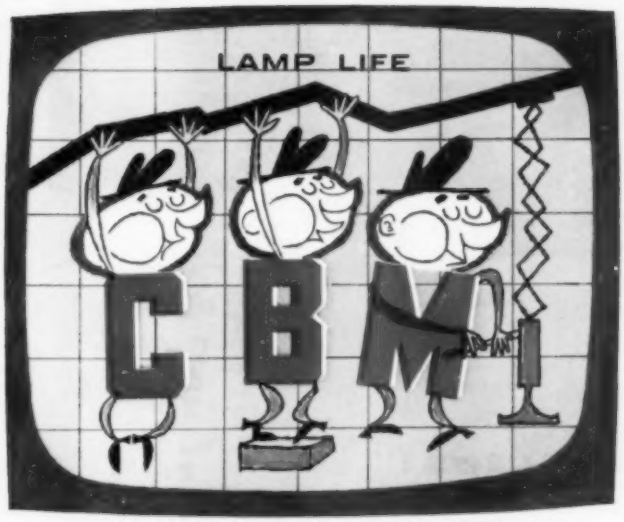
We have prepared an engineering report analyzing the cost of lighting systems using non-certified ballasts as compared with systems using CBM certified ballasts. This report shows that while the initial cost of non-certified ballasts may be a *few cents* less, lighting systems incorporating them cost the user *many dollars more* in terms of reduced lumen output and reduced lamp life.

Write today for your copy of "An analysis of fluorescent lighting system costs as affected by ballast performance".

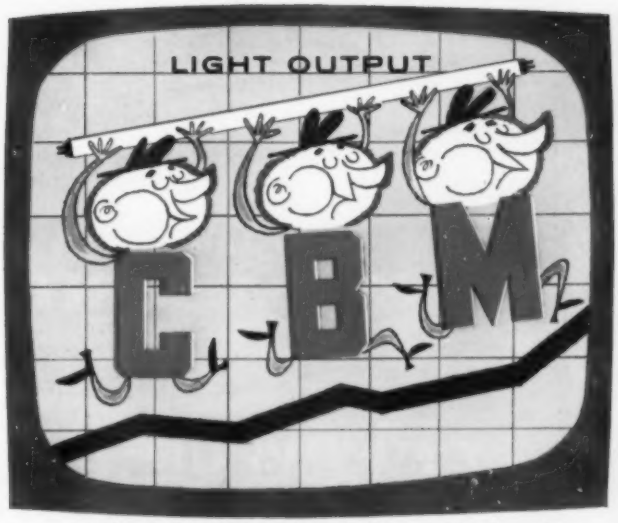
SOLA Electric Co. • **4633 West 16th Street, Chicago 50, Illinois** • **Bishop 2-1414**

CONSTANT VOLTAGE TRANSFORMERS • LIGHTING TRANSFORMERS • CONSTANT VOLTAGE DC POWER SUPPLIES
SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464
PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354 • CLEVELAND 16: 19115 Detroit Rd., EDison 3-2223 • KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382 • LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431 • SOLA ELECTRIC (CANADA) LTD., TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554 • Representatives in Other Principal Cities

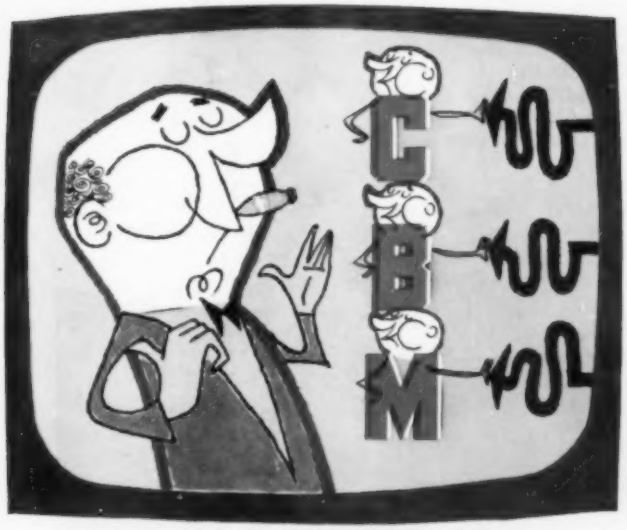
Why CERTIFIED CBM BALLASTS mean fluorescent lighting that really measures up!



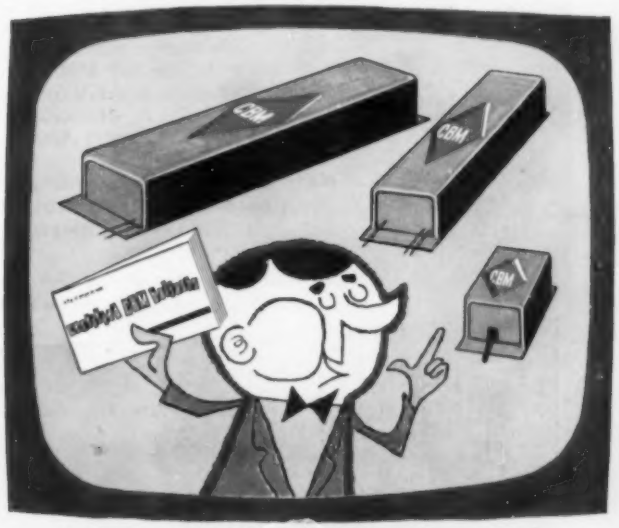
YOU GET PEAK LIGHTING PERFORMANCE with CERTIFIED CBM BALLASTS in fluorescent fixtures. And you assure customer satisfaction just as you planned because . . .



CERTIFIED CBM BALLASTS are built to exacting "specs" to give quiet operation and High Power Factor along with assured ballast life, optimum light output, and rated lamp life. And they *all* carry the UL label.



THEY PROTECT YOUR CUSTOMERS . . . help you, too. Says one lamp manufacturer, "This certification (CBM) assures without individual testing that lamps will operate at values close to ratings."



"CBM . . . INEXPENSIVE INSURANCE", says another tube maker. Be sure to specify fixtures equipped with CERTIFIED CBM BALLASTS and write for "Why it pays . . ." booklet today!

Not *all* ballasts are the same . . . Certified CBM ballasts are "tailored to the tube". Insist on CBM ballasts, *certified by ETL*, in the fixtures you choose.

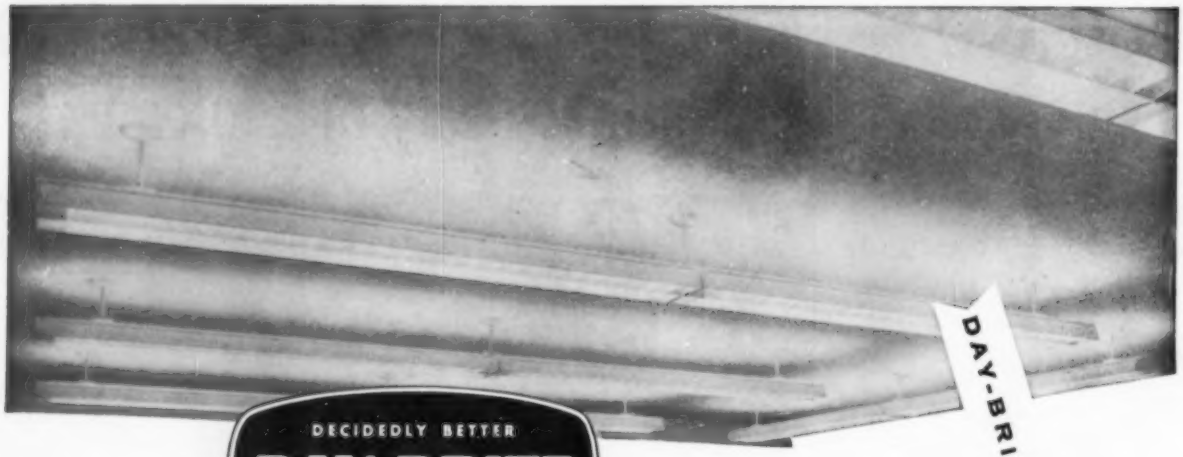
CBM CERTIFIED by ETL

Seven leading manufacturers now make up

CERTIFIED BALLAST MANUFACTURERS

2116 KEITH BUILDING • CLEVELAND 15, OHIO

Participation in CBM is open to any manufacturer who wishes to qualify



DECIDEDLY BETTER

DAY-BRITE

Lighting Fixtures

DAY-BRITE LIGHTING MAKES THE BIG DIFFERENCE HERE

No place for "substitutes!"

Today, there are many kinds of lighting fixtures on the market. But we think you'll agree that a school is no place to substitute the best lighting with fixtures producing less comfortable seeing or fewer years of satisfactory service.

Numerous institutions of all types have compared various makes of lighting—and chosen Day-Brite. You'll see the reasons why they made their decision, soon after you ask your Day-Brite representative to show you *why* Day-Brite is decidedly better. He's listed in the Yellow Pages. *Day-Brite Lighting, Inc., 5432 Bulwer Avenue, St. Louis 7, Missouri, Day-Brite Lighting, Inc., of California, 530 Martin Avenue, Santa Clara, California.*

NATION'S LARGEST MANUFACTURER
OF COMMERCIAL AND INDUSTRIAL
LIGHTING EQUIPMENT

Art room, Archbishop Hoban High School, Akron, Ohio, lighted with Day-Brite fixtures.

71137

Poly is right about EXTRU-LITE® PATTERN R1

INTEROFFICE MEMORANDUM

To: The BOSS
From: POLY

Subject: LIGHTING

Dear Boss:

Forget the raise. My eyes and I wouldn't want to leave here anyway, since you installed those new glare-free fluorescent fixtures with Extru-Lite R1 Panels.

Poly

P.S. The man who put them up said you made a smart choice. They're attractive, efficient fixtures, that are easy on the eyes -- so popular he can't keep them in stock.

BUT DEFINITELY –

You'll be seeing more and more of

EXTRU-LITE

Because you see more, more pleasantly with

EXTRU-LITE

Extru-Lite Pattern R1 is the trade name of Rotuba's Patterned Plastic Panels, designed for controlled, glare-free diffusion of light in fluorescent fixtures.

Write for sample and price information. Let your own eyes and pocketbook convince you!

ROTUBA EXTRUDERS, INC.
418 88th STREET • BROOKLYN 9, NEW YORK
SHore Road 8-5458

Phila. Office
R. L. BOUSE, FLOURTOWN, PENNA.
Tel. CHESTNUT HILL 8-1010

Makers of
PANELS • SHIELDS • DIFFUSERS
IN PLASTICS

For Modern 2-Foot-Wide Troffers...

HOLOPHANE Presents a

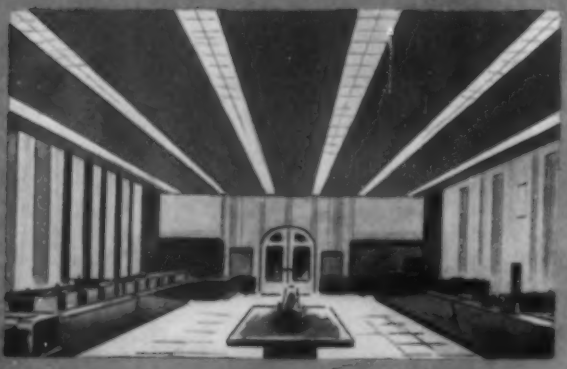
New *Flanged* Controlens*

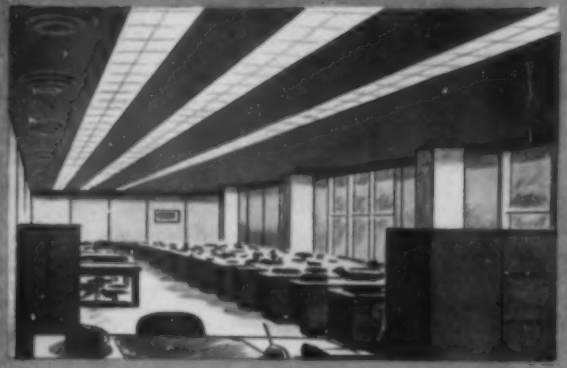
Photo: Courtesy
Litecontrol Corp.
Watertown, Mass.

No. 6025 ... Prismalume* Controlens

New Concept in Fluorescent Light Control Units...Now designed for available equipment†

Accents the New Look in Offices, Banks, Showrooms, Auditoriums, Public Buildings





† List of manufacturers who now make equipment for No. 6025 is available upon request.

Why are 2-Foot-Wide Troffers Desirable?

Because the wider lens produces high lighting efficiency with low brightness . . . assures greater visual comfort than usual narrower types . . . conforms with latest architectural techniques.

What are the Advantages of PRISMALUME?

The acrylic plastic, used in the construction of PRISMALUME CONTROLENS, provides crystal clarity, excellent color stability, lightness in weight, easy maintenance, greater safety.

How Does No. 6025 Set a New Trend?

The distinctive contour of the CONTROLENS avoids the monotony of large luminous panels. It is not a mere diffusing element, but a light-controlling lens, directing more light to the work, reducing brightness and glare. It makes possible higher illumination levels without sacrifice of comfort.

To be sure of Quality, look for the name HOLOPHANE *impressed on each piece . . .*

Holophane

HOLOPHANE
COMPANY, INC. • *Lighting Authorities Since 1898*
342 Madison Ave., New York 17, N.Y.
THE HOLOPHANE CO., LTD., 410 KIPLING AVE. SO., TORONTO 14, ONTARIO

*T.M.

Here's Another **LITECONTROL** *"Bank Statement" about High Efficiency Lighting*

The work areas . . . the traffic areas, *even the pictures on the wall*, are glarelessly illuminated in this bank installation at Greenfield, Mass. Our brand new Litecontrol 7300RS series fixture with the Holophane #6024 lens was used to assure high efficiency, low brightness and ease of maintenance by means of the hinged door.

An intriguing special note is the absence of the plastic side panels usually in evidence. This accents the attractiveness of this installation . . . lending a belief that the fixtures are recessed instead of surface mounted. Deluxe cool white lamps provide the light source.

So once again, *imagination in illumination* pays off *without* a high lighting budget. *You* can obtain similar results with standard Litecontrol fixtures. For banks, offices, stores, schools, libraries — *any* public building.

INSTALLATION:
Greenfield Savings Bank, Greenfield, Mass.

AREA:
Main Banking area.

ARCHITECT:
Howe, Prout & Ekman, Providence, R. I.

GENERAL CONTRACTOR:
Thomas J. Gass Company, Inc., Greenfield, Mass.

ELECTRICAL CONTRACTOR:
Clark Electric Company, Greenfield, Mass.

LIGHTING ENGINEER:
C. J. Forster, Jr., Western Massachusetts Electric Company, Greenfield, Mass.

CEILING HEIGHT:
9'-6".

FIXTURES:
Litecontrol No. 7344RS 4 lamp surface mounted, with steel sides, using Holophane No. 6024 acrylic lenses and deluxe cool white lamps.

INTENSITY:
Average 80 foot-candles initially.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Sylvania Reflector Fluorescent Lamps provide up to 60% more useful, directed light.

Sylvania offers a new, complete line of reflector fluorescent lamps

NOW YOU CAN ENJOY up to 60% more *useful* light with Sylvania Reflector Fluorescent Lamps . . . using your present equipment.

The new, expanded Sylvania line of reflector fluorescent lamps includes both Single-Pin and Bi-Pin types in a wide range of colors and wattages.

The reflector fluorescent lamp has a built-in reflector that directs more usable light where it is needed.

This increased, controlled brightness provides better light in bare-lamp installations without reflectors . . . or where fixture reflectors quickly accumulate light-reducing dirt.

Sylvania reflector fluorescent lamps offer high light output . . . save time and dollars usually spent on maintenance. They are particularly suited for industrial areas . . . for supermarkets and retail shops, general high ceiling strip lighting, and for *directed* light in windows, cabinets, coves, valances, etc.

For complete information about the new line of Single-Pin and Bi-Pin reflector fluorescent lamps, call your Sylvania Supplier, or write:

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Dept. 7L-3506
60 Boston Street, Salem, Mass.
In Canada, Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

SYLVANIA

. . . the fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

Sylvania Reflector Fluorescent Lamps come in a variety of colors and wattages for all fixtures.

SINGLE-PIN

Length	Watts	Bulb	Color
48"	39W	T12	Cool White
96"	73W	T12	Cool White
96"	73	T12	Warm White
96"	73	T12	Super DeLuxe Cool White

BI-PIN

Length	Watts	Bulb	Color
18"	15	T12	Cool White
18"	15	T12	Super DeLuxe Cool White
24"	20	T12	Cool White
24"	20	T12	Warm White
24"	20	T12	Super DeLuxe Cool White
36"	30	T8	Cool White
48"	40	T12	Cool White R.S.*
48"	40	T12	Warm White R.S.*
48"	40	T12	Super DeLuxe Cool White R.S.*
48"	40	T12	DeLuxe Warm White R.S.*
60"	90	T17	Cool White

*Rapid Start

Everybody Benefits...

with LPI Luv-R-Lok

Designed Especially for Schools, Stores and Offices

Architects, Engineers, Installers, Maintenance Men and Users benefit with Luv-R-Lok features.

- Available in three shieldings:
  154 Series—25° x 35°
  174 Series—35° x 45°
  194 Series—45° x 45°
- Pleasing Shallow "All Luminous" Appearance.
- Functional Modern Design.
- Translucent Side Panel without Framing to Reduce Harsh Contrasts.
- Efficient Light Control and Distribution.
- Available with Metal Side Panels.
- High Quality Baked Enamel Finish.
- Mounting Flexibility—Individually or Continuous Rows.
- CBM Certified Ballasts.
- Simple to Install.
- Rugged Construction.
- Wiring Channel Designed for Easy Access.
- Sensibly Priced.

- Louver Blades Snap-In, Snap-Out for Quick, Thorough Cleaning.
- Chain Drop on Reflector for Quick Relamping.

6945

Mail This Coupon Today

LIGHTING PRODUCTS INC. Dept. 6F Highland Park, Illinois

Gentlemen: Please send me Literature on the LPI Luv-R-Lok.

Name_____ Title_____

Firm_____

Address_____

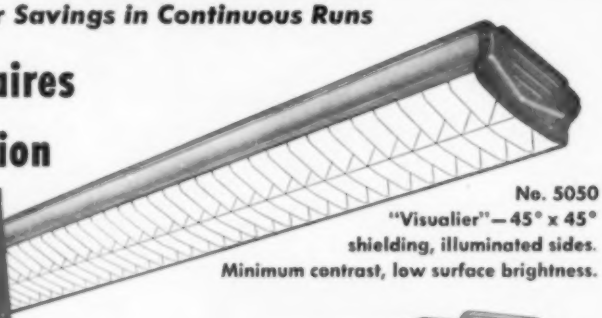
City_____ Zone_____ State_____

Over 50% Labor Savings in Continuous Runs

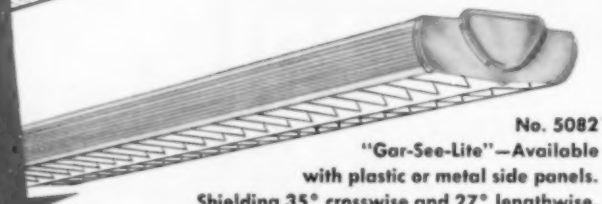
Premium Quality Luminaires for Speed-Line Installation

THIS IS THE GARCY Speed-line® PATENT PENDING SYSTEM

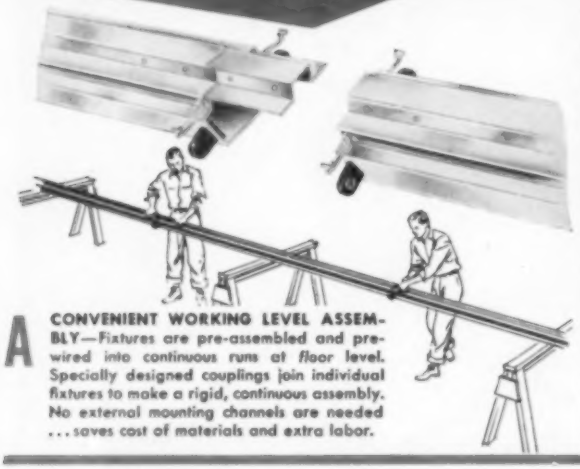
optional at no extra cost with Garcy Visualier and Gar-See-Lite Fixtures



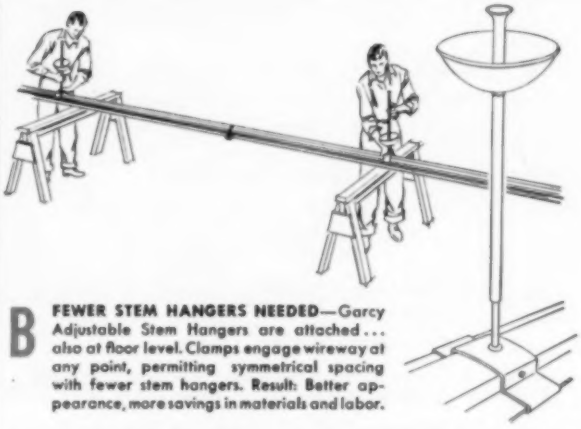
No. 5050
"Visualier"—45° x 45° shielding, illuminated sides.
Minimum contrast, low surface brightness.



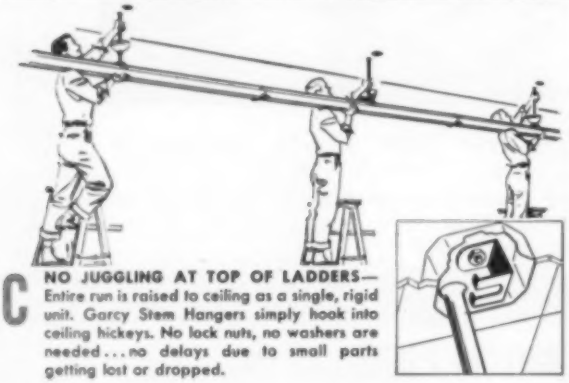
No. 5082
"Gar-See-Lite"—Available with plastic or metal side panels.
Shielding 35° crosswise and 27° lengthwise.



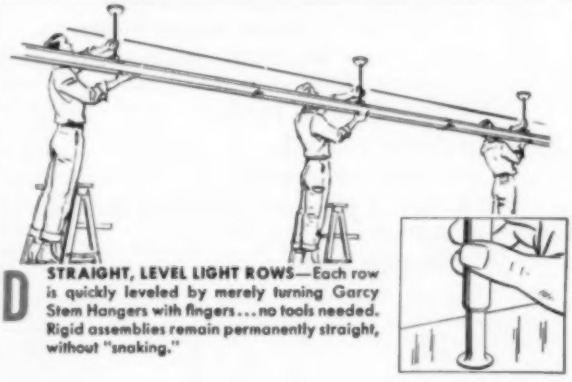
A **CONVENIENT WORKING LEVEL ASSEMBLY**—Fixtures are pre-assembled and pre-wired into continuous runs at floor level. Specially designed couplings join individual fixtures to make a rigid, continuous assembly. No external mounting channels are needed ... saves cost of materials and extra labor.



B **FEWER STEM HANGERS NEEDED**—Garcy Adjustable Stem Hangers are attached ... also at floor level. Clamps engage wireway at any point, permitting symmetrical spacing with fewer stem hangers. Result: Better appearance, more savings in materials and labor.



C **NO JUGGLING AT TOP OF LADDERS**—Entire run is raised to ceiling as a single, rigid unit. Garcy Stem Hangers simply hook into ceiling hickeys. No lock nuts, no washers are needed ... no delays due to small parts getting lost or dropped.



D **STRAIGHT, LEVEL LIGHT ROWS**—Each row is quickly leveled by merely turning Garcy Stem Hangers with fingers ... no tools needed. Rigid assemblies remain permanently straight, without "snaking."

Send today for Bulletin 551-L

GARCY
Preferred for Performance
COMPLETE COMMERCIAL LIGHTING

Garden City Plating and Manufacturing Company
1730 North Ashland Avenue • Chicago 22, Illinois
In Canada: Garcy of Canada, Ltd., 1244 Dufferin Street, Toronto 4

(*Continued from page 32A*)

gia, where he will work jointly with **Furna E. Lott** who has represented Miller in Florida for a number of years; **Donald W. Goodwin** in the Washington, D. C., area, succeeding **Crawford Maddox** who is retiring; **Ernest Voos** in the Philadelphia-Wilmington area, working with **P. R. Steele** who has been in this territory for some time; **Donald R. Potter** in northeastern Ohio, working with **William A. Hancock**; **J. Gordon McDonald** who has joined the Thorsell Lighting & Equipment Co. who represent the company in Kansas, western Missouri and Ottawa county in Oklahoma; and **Thomas J. Evans** in northern Illinois, eastern Iowa, northeastern Missouri and southwestern Wisconsin.

William B. Beggs has been named assistant to the sales manager of the Atlantic region for the Westinghouse Lamp Division. Mr. Beggs, who was formerly a sales representative in the Newark district, will make his headquarters in Philadelphia.

Westinghouse Lamp Division has named **Donald M. Canfield** assistant to the sales manager of the central region, with headquarters in Pittsburgh. Prior to this appointment, Mr. Canfield was on special field assignments from the division headquarters.

Universal Manufacturing Corp., Paterson, N. J., has announced the opening of its Western Regional sales office and distribution warehouse in Los Angeles. **George J. Kaufman,** who has been affiliated with Universal for six years, has been appointed Regional Manager of the newly-formed branch.

Lou Stark, of Markel Electric Products Inc., is limiting his activities for the company to the New York City and Newark areas, in anticipation of retirement after a few years. Markel announces the appointment of the Jae and Meyer Co., Inc. of Mount Vernon, N. Y., as their new representative organization. **David Jae** and **Perry Meyer** head the company.

Formation of a contract division to sell Alzak and anodized aluminum processing to the metal-finishing industry has been announced by Curtis Lighting, Inc., Chicago. **Kenneth L. Sunderman** has been named sales representative for the new division. Mr. Sunderman has been with Curtis for two years as an industrial engineer.

Deaths

J. R. Colville, Jr., Indiana Section.
B. A. Dahlin, Chicago Section.
Robert E. Lloyd, Southern California Section.
Dwight R. Venell, Chicago Section.
J. F. Wagner, Indiana Section.

BOOKS AND PAMPHLETS

Elements of Color in Professional Motion Pictures, edited by Wilton R. Holm, published by Society of Motion Picture and Television Engineers, 55 West 42nd St., New York 36, N. Y., 1957, 104 pages, 27 pages in color. $3.50.

This book represents more than a year's work by members of a special committee under the SMPTE Color Committee and has been prepared for those who work with color film — artist or engineer, craftsman or laboratory and production worker.

There are twelve chapters with such titles as: Color Fundamentals, Characteristics of Color, Color Films and Processes, Photographing a Motion Picture in Color, Color Photography Outdoors, Color Photography in the Studio, Special Effects. Topics such as: nature of light, color vision, color mixture, color temperature and the effects of lighting in color photography are included and should be of particular interest to the illuminating engineer.

Planned Artificial Lighting, by John W. T. Walsh, O.B.E., M.A., D.Sc., M.I.E.E., published by Odhams Press Limited, 96 Long Acre, London, England, 1957, 192 pages, illustrated and indexed. 25s. net.

It is the aim of this British book to show how a lighting installation can be planned to satisfy a set of specified requirements, indicating what kinds of lighting equipment are available to the designer and giving guidance as to the proper choice under particular circumstances. There are twenty chapters of which the first three deal with lighting requirements, the next six with lamps and "fittings," the next six with general lighting design and the last five with special problems for which methods of design were not described earlier in the book.

The author is the current president of the International Commission on Illumination and a Past President and Hon.

(*Continued on page 46A*)

Garcy Lighting Expands to Give Better Service
Now! Two Plants in Chicago
for Faster Production and
Larger Stocks of
Garcy Lighting Fixtures
NEW! Plant No. 2—2501 North Elston Avenue
Plant No. 1—1750 North Ashland Avenue
GARCY
GARDEN CITY PLATING and MANUFACTURING COMPANY
1750 North Ashland Avenue • Chicago 22, Illinois
IN NEW YORK CITY
48 West 48th Street
Phone: Plaza 7-1580
IN LOS ANGELES
Garcy Western Corp.
3912 Broadway Place
Phone: ADams 3-6293
IN CANADA
Garcy Co. of Canada, Ltd.
1244 Dufferin St., Toronto 4, Ont.
Phone: LEnnox 1-3151

to get the most out of ellipses

Until the inside of an elliptical vessel could be given a non-tarnishing surface, the ellipse couldn't fulfill one of its best uses — to gather and reflect light. Century makes a full line of Downlites with precisely formed ellipsoidal Alzak reflectors to get better light from low cost general service lamps

CENTURY LIGHTING, INC.

521 WEST 43rd ST.
NEW YORK 36, N. Y.

1820-40 BERKELEY ST.
SANTA MONICA, CALIF.

1477 N.E. 129th ST.
N. MIAMI, FLORIDA

(*Continued from page 45A*)

Member of the Illuminating Engineering Society (British).

Analysis of Electric Circuits, by William H. Middendorf, published by John Wiley & Sons, Inc., 440 Fourth Ave,. New York 16, N. Y., 306 pages, illustrated and indexed. $6.00.

Basing his presentation on successful experience in his own classroom, the author treats only those topics most essential to a basic understanding of circuit analysis. The basic concepts are presented in detail and are accompanied by numerical examples and problems.

The book is arranged into three sections, the first providing that which is necessary to meet circuit analysis problems encountered in the undergraduate college courses, and the latter two extending the scope for electrical engineering majors.

The author is now Assistant Professor of Electrical Engineering at the University of Cincinnati.

Selling Color to People, by Faber Birren, published by University Books, Inc., 404 Fourth Ave., New York 16, N. Y., 1956, 219 pages, illustrated. $7.50.

It is the purpose of this book to provide business executives, sales managers, salemen, designers, stylists, advertising men and research specialists, with answers to commercial color problems. The book has data on market studies, consumer polls, and retail sales tests and presents information on visibility and legibility, together with human interest data on visual, mental and emotional reactions to color.

Among the subjects treated are: color research, color in merchandising, color for advertising, vision, visibility, legibility, color television, color and human personality, and color harmony.

Electrical Systems Design, by Joseph F. McPartland and the Editors of *Electrical Construction and Maintenance*, published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y., 1957, 140 pages, illustrated and indexed, clothbound. $6.00

The purpose of this book is to set forth standards of good electrical systems design that are found in actual current practice. It covers the design and layout of electrical systems for power, light, heat and communications in commercial, industrial, institutional and residential buildings.

There is a chapter on lighting design which deals with such topics as: selection of lighting systems, lighting calculations, supplementary lighting, color in lighting and residential lighting. Material for this was provided by Berlon C. Cooper, Eastern Editor of *Electrical Construction and Maintenance*.

Electrical Engineering Circuits, by Hugh Hildreth Skilling, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 724 pages. $8.75.

Concepts stressed in this book are network theorems, loop and node equations of networks, locus curves and other graphical methods, resonance of high-Q circuits, impedance and admittance functions, poles and zeroes in the complex frequency plane, the transform concept and the Laplace transformation. Attention is also devoted to the algebra of complex quantities.

Dr. Skilling is professor of electrical engineering and head of that department at Stanford University.

Windows and Glass in the Exterior of Buildings, published by the Publications Office, National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C. 176 pages. $5.00.

The official record of the Building Research Institute conference last November, this book contains reports by 24 specialists on daylighting, air-conditioning, heating, ventilating, interior and exterior controls, window and glass production, and residential, commercial and institutional design. Their opinions are given on the advantages and disadvantages incurred by the continually growing use of glass in all types of present-day construction.

ASTM Standards on Plastics, published by the American Society for Testing Materials, 1916 Race St., Philadelphia, Pa. Paper cover, 6 x 9-inch, 871 pages. $6.00.

This compilation of ASTM Standards on Plastics contains 40 specifications, 93 methods of tests, 19 recommended practices and 5 definitions. Of these 34 are new or revised. Most of the standards were prepared under the jurisdiction of the ASTM Committee D-20 on Plastics, although certain of those in the field of electric insulation are the work of Committee D-9.

Among the topics covered are the mechanical, thermal, optical and performance properties of plastics. Also included are standards for molding compounds, standard shapes and molds, analytical methods, compounding and electrical tests specifications for plastics. An Appendix contains two proposed standards presented for information.

(**Continued on page 48A**)

. . . the man from *Smithcraft*

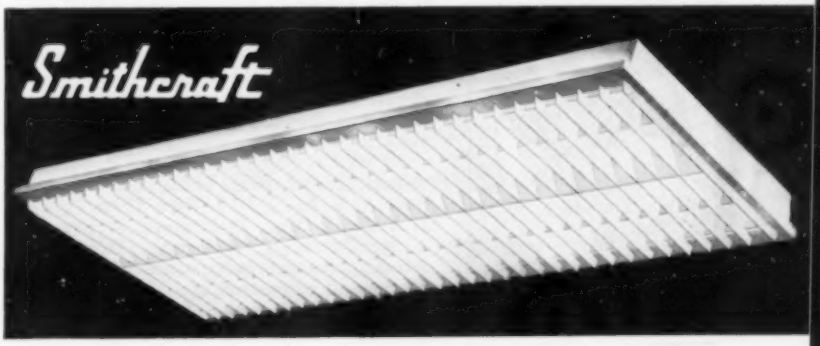
*John E. Artopoeus of Artopoeus-Smith Company, Northern Ohio representatives, one of Smithcraft's nationwide sales-engineer organization.

Whether he's in your office to bring you up-to-date on the newest development in shielding or out on the job to survey lighting requirements, his primary concern is to help you get the most out of every dollar ear marked for lighting! You can depend on his judgement because his reputation in the industry has been built on talking facts to men like yourself who want and need straight answers about lighting. You'll find it pays to call him!

. . . another NEW luminaire from

EXECUTIVE

a new very wide and shallow all-steel fluorescent unit with self illuminated sides



This new Smithcraft development solves the problem of lighting in low ceiling interiors. Only 3 1/32" deep, EXECUTIVE offers a soft, eye-pleasing overall appearance, with the metal sides illuminated by light from the fixture itself to minimize contrast. The shielding provided by the rigid louver is 30° crosswise and 45° lengthwise. Available in 4' and 8' lengths, for 2 or 4 Rapid-Start or Slimline lamps. For distinctive, modern illumination, the EXECUTIVE is a very useful and attractive new lighting tool.

Smithcraft fluorescent lighting units are installed in thousands of offices, factories, stores, schools and diversified interiors from coast to coast. Wherever good lighting is important, you'll find . . .

Smithcraft — "AMERICA'S FINEST FLUORESCENT LIGHTING"

CHELSEA 50, MASSACHUSETTS

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☐ Please send me the monthly publication, "Light Side of the News", so that I can keep in touch with the latest trends in lighting.

☐ Please send me the "EXECUTIVE" Folder and catalog sheets.

☐ Please send me the complete SMITHCRAFT CATALOG, containing data on America's Finest Fluorescent Equipment.

NEW Revere Urban-Lite

ELECTRIC MFG. CO. CHICAGO, U.S.A.

END MOUNTING LUMINAIRE

for

250 WATT H-5
175 WATT H-22
100 WATT H-4
HORIZONTAL BURNING
MERCURY LAMPS OR
MULTIPLE INCANDESCENT
LAMPS UP TO 4000 LUMENS

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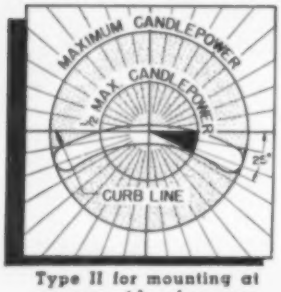
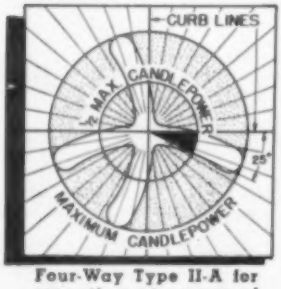


Type II for mounting at or near side of narrow roadway.



Four-Way Type II-A for mounting at corner of intersection.

Here's *the* Luminaire for lighting residential areas or for any street where uniform low-level lighting is desired. It provides an economical means of utilizing the smaller, highly efficient Mercury Lamps where higher intensities are not required, or it can also be used with multiple incandescent Lamps up to 4000 lumens.

Its sturdy, one-piece reflector housing with proper glassware is designed to produce A. S. A. - I. E. S. Type II or Type II-A distribution. It is made of heavy gauge aluminum. Reflecting surface is Alzak processed to produce high efficiency and utilization of light. Housing is supported by a gasketed cast aluminum neck having an end-mounting slip fitter for 1¼ in. or 2 in. pipe and is adjustable 4° above or below horizontal.

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A fitting companion to Revere "Star-Lux" and "Endoval" Luminaires. Write today for Bulletin 700-51.

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THE ONLY COMPLETE LINE OF LUMINAIRES - FLOODLIGHTS AND POLES FOR STREET - SPORTS AIRPORT - SERVICE STATION - OUTDOOR THEATRE - MARINE AND INDUSTRIAL LIGHTING

(*Continued from* 46A)

Report and Evaluation of National Electrical Week, prepared by the National Electrical Week Committee, meeting in Chicago, Ill., March 31, 1957. 43 mimeographed pages.

This report contains an analysis of the 1957 "Week," industry reactions, the proposed 1958 program, and an appendix of reporting communities and national advertisers' support.

Valance, Cornice and Cove Lighting (A-6797), available from Westinghouse Lamp Division offices.

This 8-page booklet replaces the 1953 edition, and includes information on dimming and photographs of typical installations. For lecture use, a set of 14 2 x2-inch Kodachrome slides of valance, cornice and cove lighting with an accompanying script is available.

Prices for the booklet are: quantities up to 1000, 5 cents per copy; more than 1000, 4 cents per copy. The slides with script are $7.00 per set.

NEMA Standards for Metallic Rectifiers, published by the National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y. $3.50.

A new revision, of the 1953 edition, of standards covering products and applications in the semiconductor industry, this publication was produced by the NEMA Semiconductor Rectifier Section.

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee held at New York, N. Y. on May 8, 1957, the following were elected to membership. Names marked * are transfers from Associate Member Grade.

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ARIZONA SECTION

Members:

*Benndorf, William, William Benndorf Co., Phoenix, Ariz.

Smart, J. W., Arizona Public Service Co., Prescott, Ariz.

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Nichols, N. B., 2509 Bishop, Little Rock, Ark.

ARK-LA-TEX CHAPTER

Member:

Hengy, G. C., George C. Hengy Co., Shreveport, La.

(*Continued on page* 49A)

(*Continued from page 48A*)

BRITISH COLUMBIA SECTION

Associate Members:

Cave, H. L., Cave Electric Service, Vancouver, B. C.

Holmes, Roy, Vancouver Lighting Co. Ltd., Vancouver, B. C.

CHICAGO SECTION

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Daily, H. J., Graybar Electric Co. Inc., Chicago, Ill.

Moore, P. B., Graybar Electric Co. Inc., Chicago, Ill.

Student Members:

Cohen, K. J., University of Illinois, Urbana, Ill.

Peterson, R. A., University of Illinois, Champaign, Ill.

CHINOOK CHAPTER

Associate Member:

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Member:

Stark, E. M., Green-Smith Associates, Painesville, Ohio.

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Associate Members:

Hayden, F. P., Westinghouse Electric Corp., Hartford, Conn.

Poulson, Oscar, Jr., Westinghouse Electric Corp., Hartford, Conn.

EASTERN PENNSYLVANIA SECTION

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Fosnocht, W. H., Jr., William Fosnocht & Son, Pottstown, Pa.

McLaughlin, J. W., Pennsylvania Power and Light Co., Scranton, Pa.

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Tunstall, A. A., Swift Canadian Co. Ltd., North Edmonton, Alta.

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Ort, A. W., City of Clearwater, Clearwater, Fla.

GEORGIA SECTION

Member:

Chappell, H. R., Walker Electrical Co., Atlanta, Ga.

Associate Member:

Callaham, J. F., Jr., Georgia Power Co., Atlanta, Ga.

GOLDEN GATE SECTION

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Brass, J. R., State of California, Division of Highways, San Francisco, Calif.

IOWA SECTION

Member:

*Rafferty, L. D., Interstate Power Co., Clinton, Iowa.

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Kleis, C. R., Crescent Electric Supply Co., Ottumwa, Iowa.

Myers, J. D., Meredith Publishing Co., Des Moines, Iowa.

Neal, J. B., Iowa State Teachers College, Cedar Falls, Iowa.

(*Continued on page 51A*)

NEW FROST-WHITE shields defy destruction. Bend them like this or jump on them. They won't shatter. Breakage in shipping and handling is thus minimized.

NOW USE THINNER SECTIONS, CUT SHIELD COST WITH SHEFFIELD FROST-WHITE* STYRENE

Now you can design thinner, lighter, polystrene shields for fluorescent fixtures and cut their cost without risk of excessive breakage or premature discoloration!!

Sheffield's new FROST-WHITE styrene shields are practically indestructible. They have 5-6 times the resiliency and light stability better than regular styrene shields. They show no excessive discoloration after 20,000 lighting hours of use.

Although made of an impact grade of polystyrene, they have a bright, white initial color and high light transmission. And their velvety surface finish absorbs stray light, cuts out eye-straining reflections. Their cost? The same as regular styrene shields of equal weight!!

FROST-WHITE shields open new design possibilities — especially for modern snap-in panels and diffusers. If you have not investigated these unique diffusers yet, we will be glad to supply complete details. Write us at Sheffield Plastics, Inc., Dept. 74-B, Sheffield, Mass.

Precision Engineered Rigid Plastic Extrusions

* TRADEMARK

SHEFFIELD PLASTICS INC.
SHEFFIELD, MASS.

What Do You Mean, You Don't Like Competition?

Once there was a little company that made fluorescent lighting fixtures. Oh, it had a president, and an engineer, and a production man, and a salesman, a secretary, and even an advertising manager. But it was still a small company—because all these "officers" were the same man. All except the secretary, that is. SHE was the other 50 percent of the company. (The poor guy never *has* learned to type.)

Well, you know how America is . . . for the right man, the right product, the right combination of hard work and application. And luck, of course. And—of all things—competition. That's right! The "little" company now has nearly 100 employees, a fully trained and seasoned staff of representatives in the field, and a national reputation for making fluorescent fixtures of quality at a very competitive price.

You've got to give the competition a lot of credit for this success. Competition kept the firm on its toes, made it find ways to do things more efficiently and economically. Made it improve its fixtures . . . and then improve them some more. Made it dwell everlastingly on service, service, service. Made it GOOD, from start to finish.

Today, this company is giving just about the fastest, most efficient, most personally interested service—on every order—ever known in its field. You've probably already guessed our name. It's . . .

LIGHT & POWER UTILITIES CORP.

1035 FIRESTONE BLVD., MEMPHIS, TENN.

DOMES Recessed and Pendant

Kurt Versen dome fixtures give highest quality indirect lighting—glare free and shadowless with wide lateral distribution, low-brightness and top efficiency. Pre-wired, recessed models feature the patented NO FRAMING* installation method which is simple, rapid and inexpensive. Pendant fixtures have twist-proof swivels* which always hang straight and permit installation on ceilings up to 28° pitch. Wide selection of models beautifully designed, carefully made and competitively priced. Rapid delivery from stock. Write for catalog.

kurt Versen COMPANY
contemporary lighting
Englewood 14, New Jersey

*U. S. PAT. 2,486,903; 2,614,785; 2,516,661

(Continued from page 49A)

Phillips, J. A., Terry-Durin Co., Cedar Rapids, Iowa.
Pulley, F. L., 720 Securities Bldg., Des Moines, Iowa.
Rogers, H. D., Meredith Publishing Co., Des Moines, Iowa.

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Wainio, A. W., Westinghouse Electric Corp., Bloomfield, N. J.
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Jordan, T. R., McGraw-Hill Publishing Co., New York, N. Y.
McCarthy, William, Public Service Electric & Gas Co., Englewood, N. J.
Moskovitz, Arthur, Ebasco Services Inc., New York, N. Y.
Ronayne, J. H., General Electric Co., New York, N. Y.

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Duffey, B. E., Westinghouse Electric Corp., Dallas, Texas.
Frauman, Myer, Frauman Electric Co., Dallas, Texas.

(Continued on page 53A)

Keeping industry bright with ABolite

High bay factory lighted by 500-watt incandescent lamps in Abolite GBF Protecto Shields.

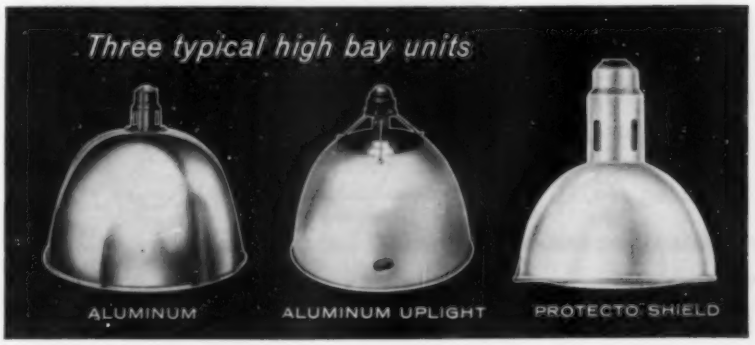
For high bay installations...

Specify self-cleaning Abolite units for long lamp life, low maintenance

The self-cleaning action of Abolite lighting fixtures makes them ideal for high bay installations, where maintenance is difficult and costly. All high bay fixtures developed by Abolite have either slotted-necks or open-top designs. Air circulation through these openings keeps the reflector surface swept clean, reduces lamp operating temperatures. Lighting efficiency remains high. Replacement costs are lower because cooler lamps last longer.

Abolite has a complete line of high bay fixtures, including RLM-approved Alzak aluminum and porcelain enamel types for use with all kinds of mercury and incandescent lamps. For full details, write *Abolite Lighting Division, The Jones Metal Products Co., West Lafayette, Ohio.*

ABOLITE Lighting



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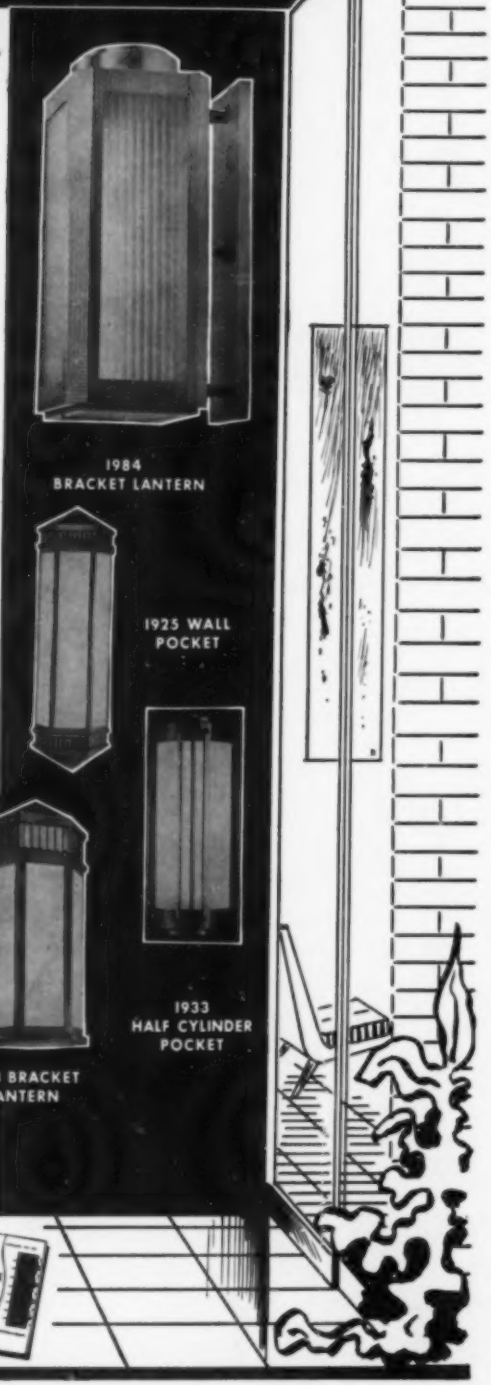
Series 1941 and 1933 available in smooth surface only. Series 1925, 1984, and 1988 available in smooth or embossed, natural satin surface.



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Specific territory open. Sales representative or sales organization wanted to contact architects, engineers, contractors and electrical distributors to sell nationally known commercial, industrial and institutional lighting line, meeting today's competition and tomorrow's future design. We are Holophane licensees and members of the RLM Standards Institute. Due to our new accelerated sales program, many new territories are open (protected). We have just completed our 1957 catalogue which is ready for national mailing. Kindly contact Box 277, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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Experienced in lighting fixture design and layout for commercial and institutional use. Excellent opportunity. Submit full resume, background, salary, etc. All replies held strictly confidential. Address Box 305, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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Sales organizations with allied lines wanted to contact Lighting Engineers, Electrical Contractors and Distributors. This is a nationally known, extensive fluorescent and incandescent lighting line. Due to our new sales program, many new protected territories are open. In answering, please specify entire territory desired and lines now represented. Send full details to Box 308, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

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(*Continued from page 51A*)

Hargrave, Cecille T., Interiors by Cecille, Dallas, Texas.
Osborn, Mrs. Geth, Geth Osborn, Interiors, Dallas, Texas.

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Lapointe, H. J., Kehne Electric Co. Inc., St. Paul, Minn.
Ludwig, Herman, Kehne Electric Co. Inc., St. Paul, Minn.
Noyes, C. J., Kehne Electric Co. Inc., St. Paul, Minn.
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SIMPLE — POSITIVE LATCH
FOR EASIER MAINTENANCE
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by HUGHEY & PHILLIPS, INC.
— your most dependable source of
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MODEL OB21 is of the SIDE ENTRANCE conduit fitting type in order to facilitate installation on horizontal conduit runs. Available in ¾" or 1" conduit tap

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Manufacturers of
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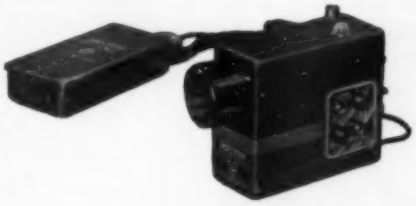
SPECTRA BRIGHTNESS SPOT METER



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DIRECT READING! All operators will obtain the same reading of the brightness of a given area.

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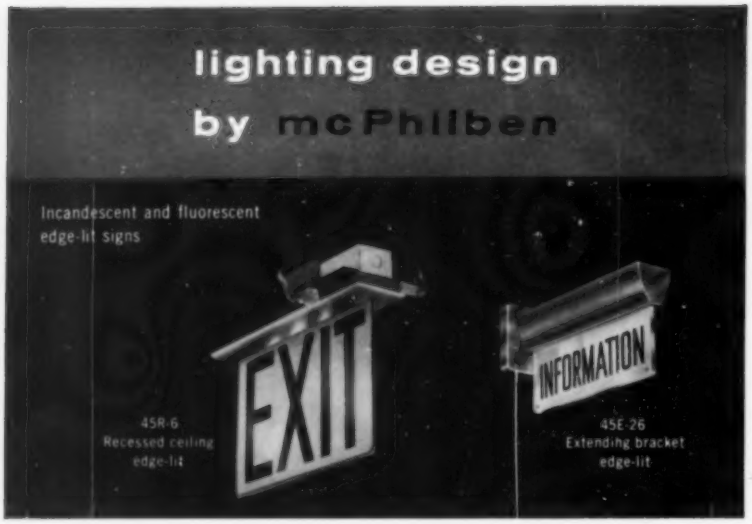

CAST ALUMINUM QUALITY

The gleaming satin finish of these mcPhilben directional units will blend with the interior door and window frames of the handsome new Philadelphia Sheraton Hotel. Invisible hardware permits flush installation so necessary to streamlined modern decorating. Solid cast aluminum construction assures permanent maintenance-free operation. Hinged access doors provide for easy relamping.

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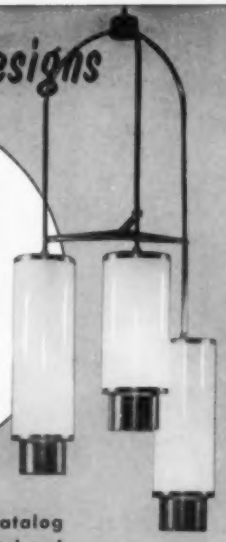

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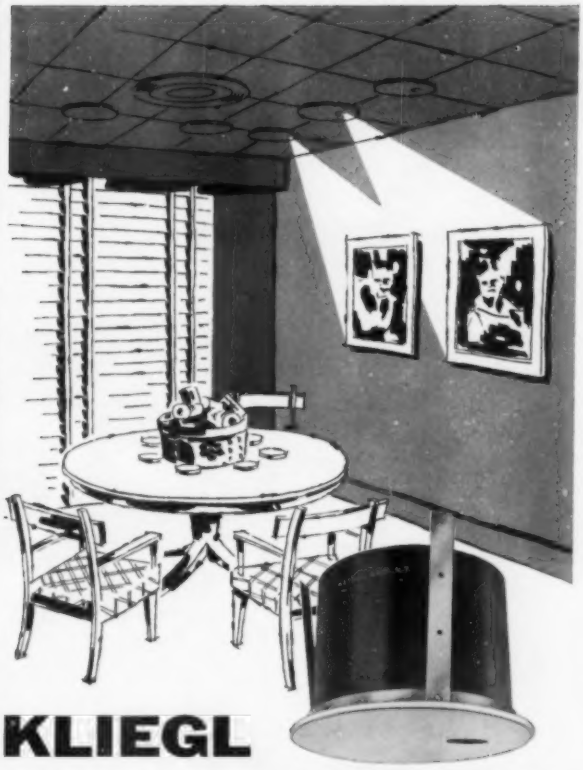

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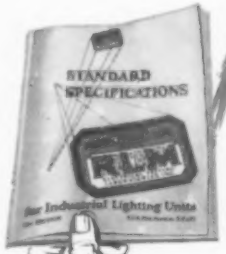

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